TECHNOLOGY DEPT.

Gas Journal

VOL. 281. 107th YEAR. LONDON, MARCH 23, 1955. Nº 4790. PRICE 1/3

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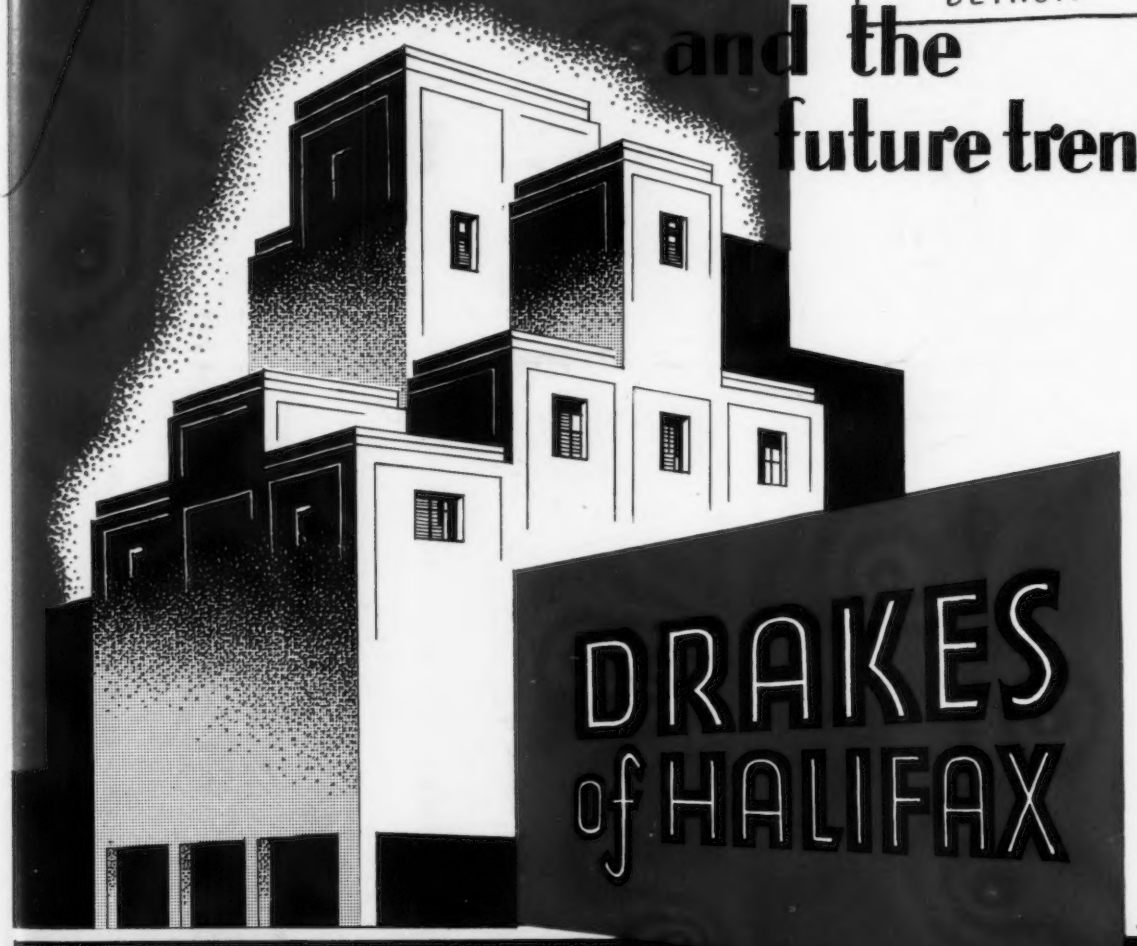

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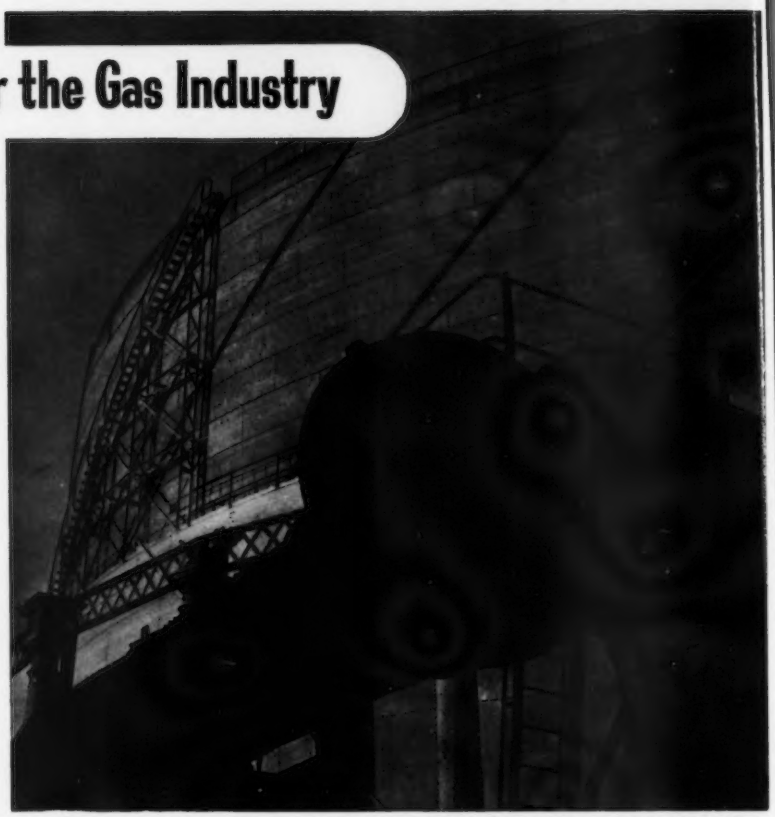

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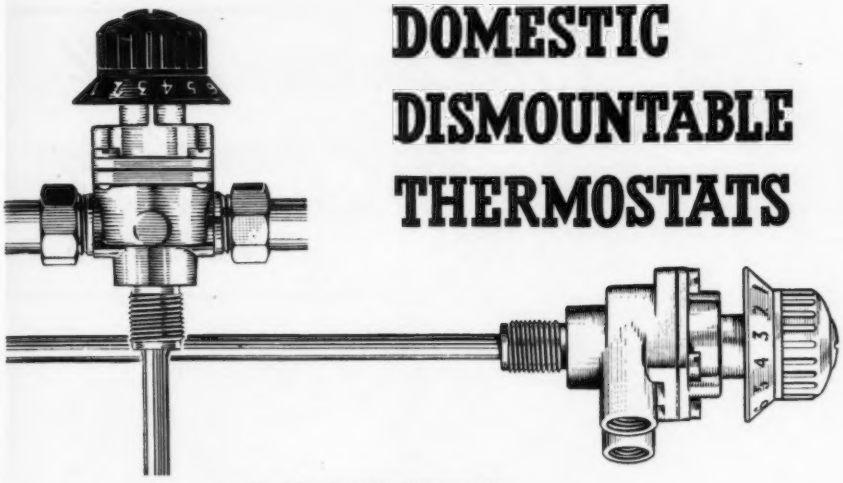

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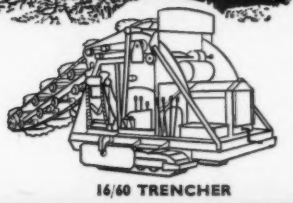

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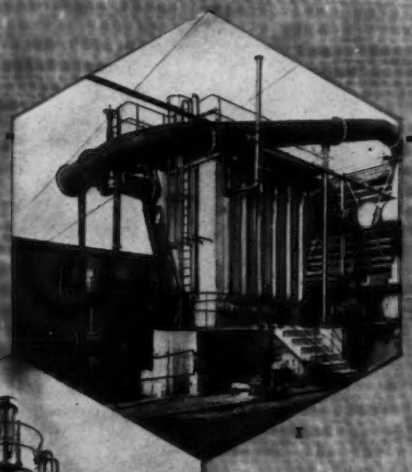
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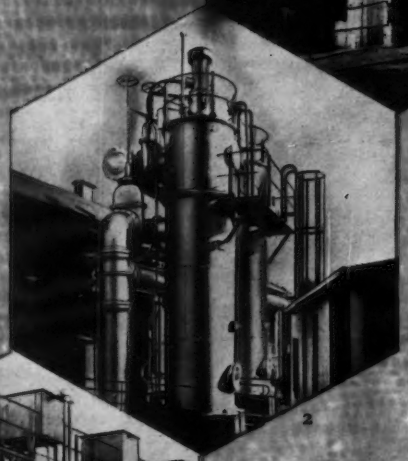
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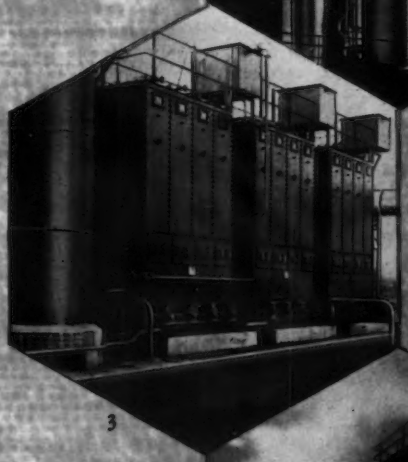
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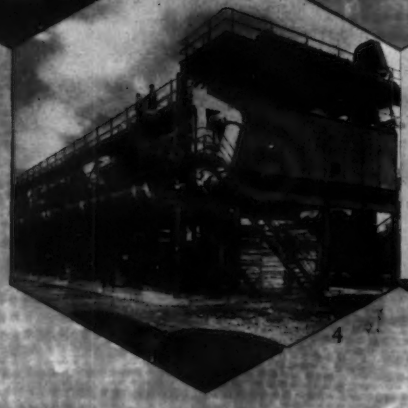
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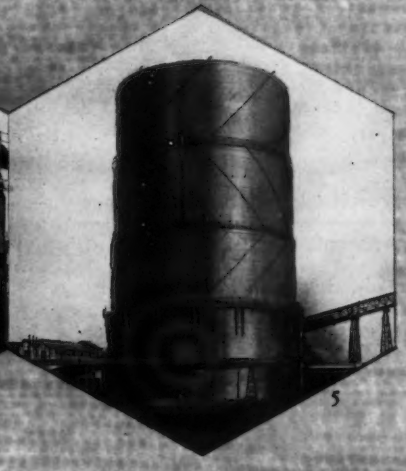
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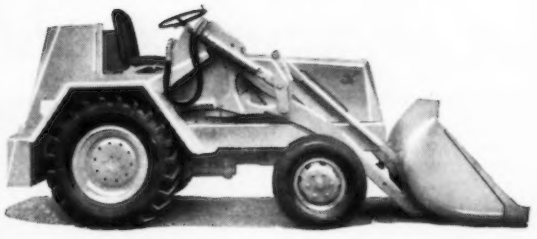

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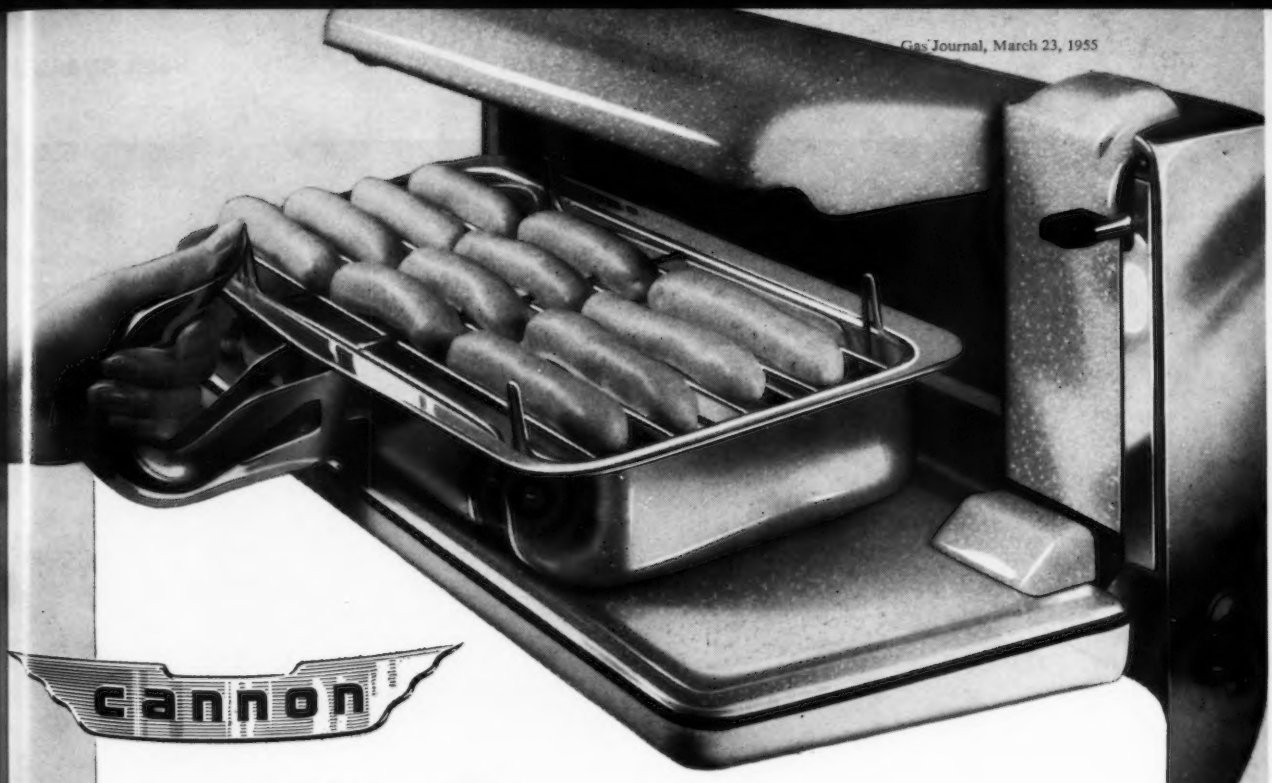

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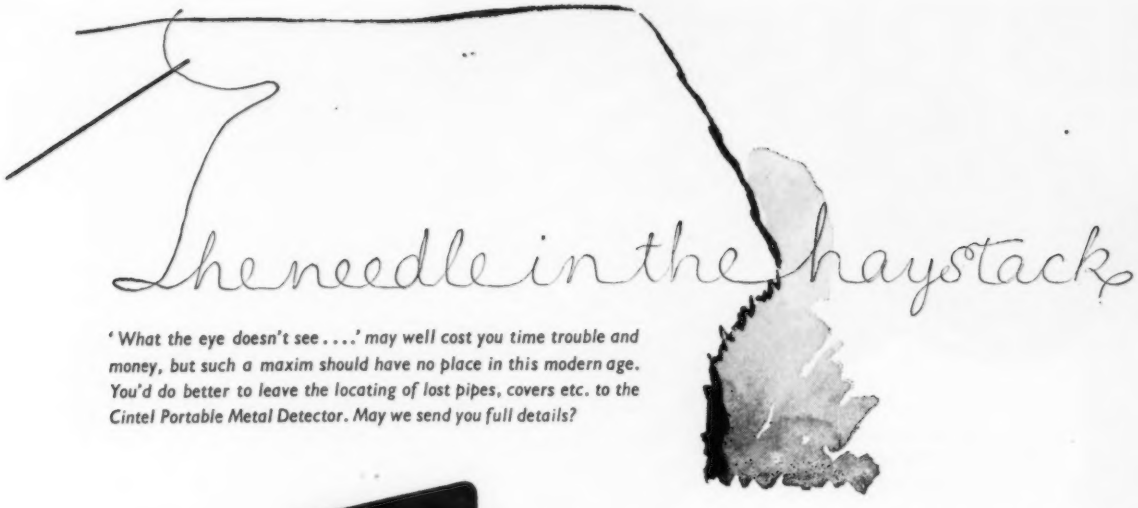

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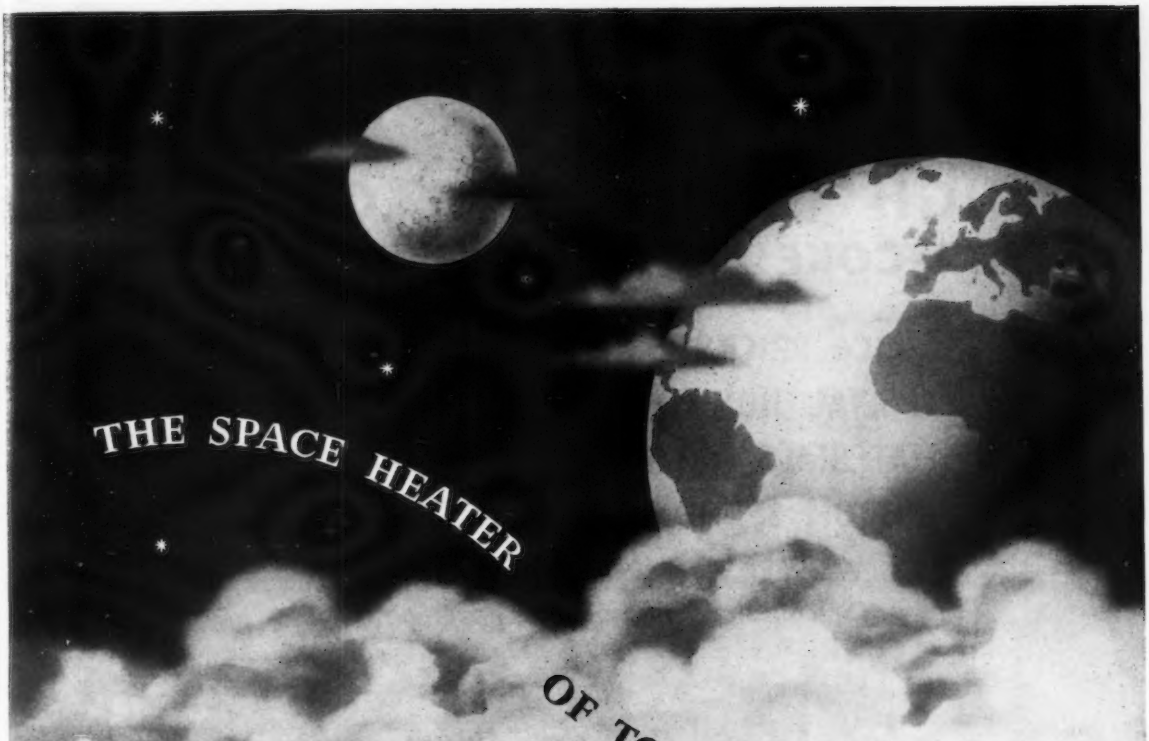

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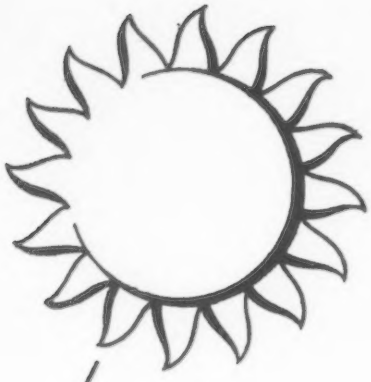

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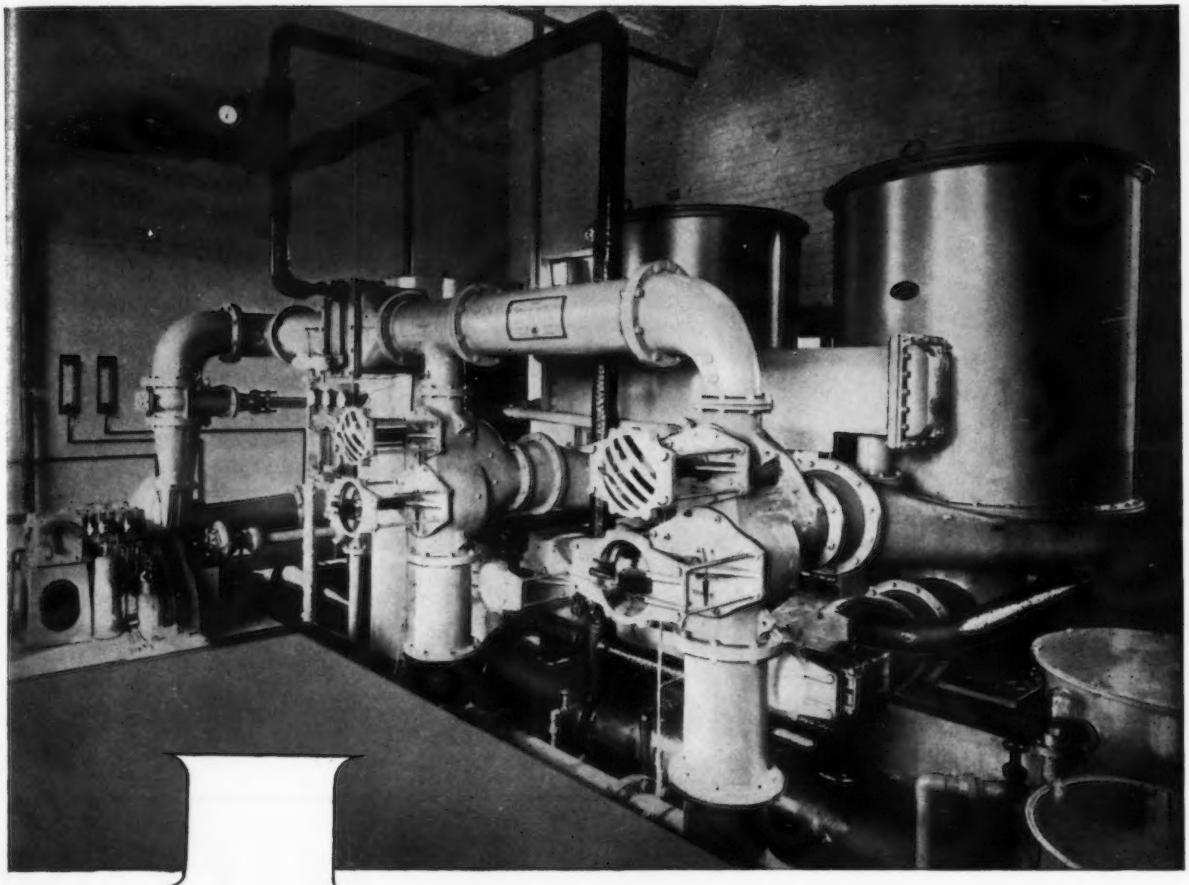

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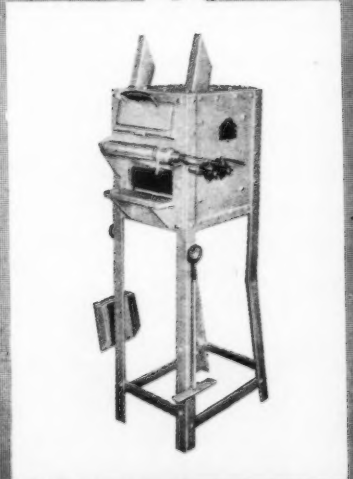

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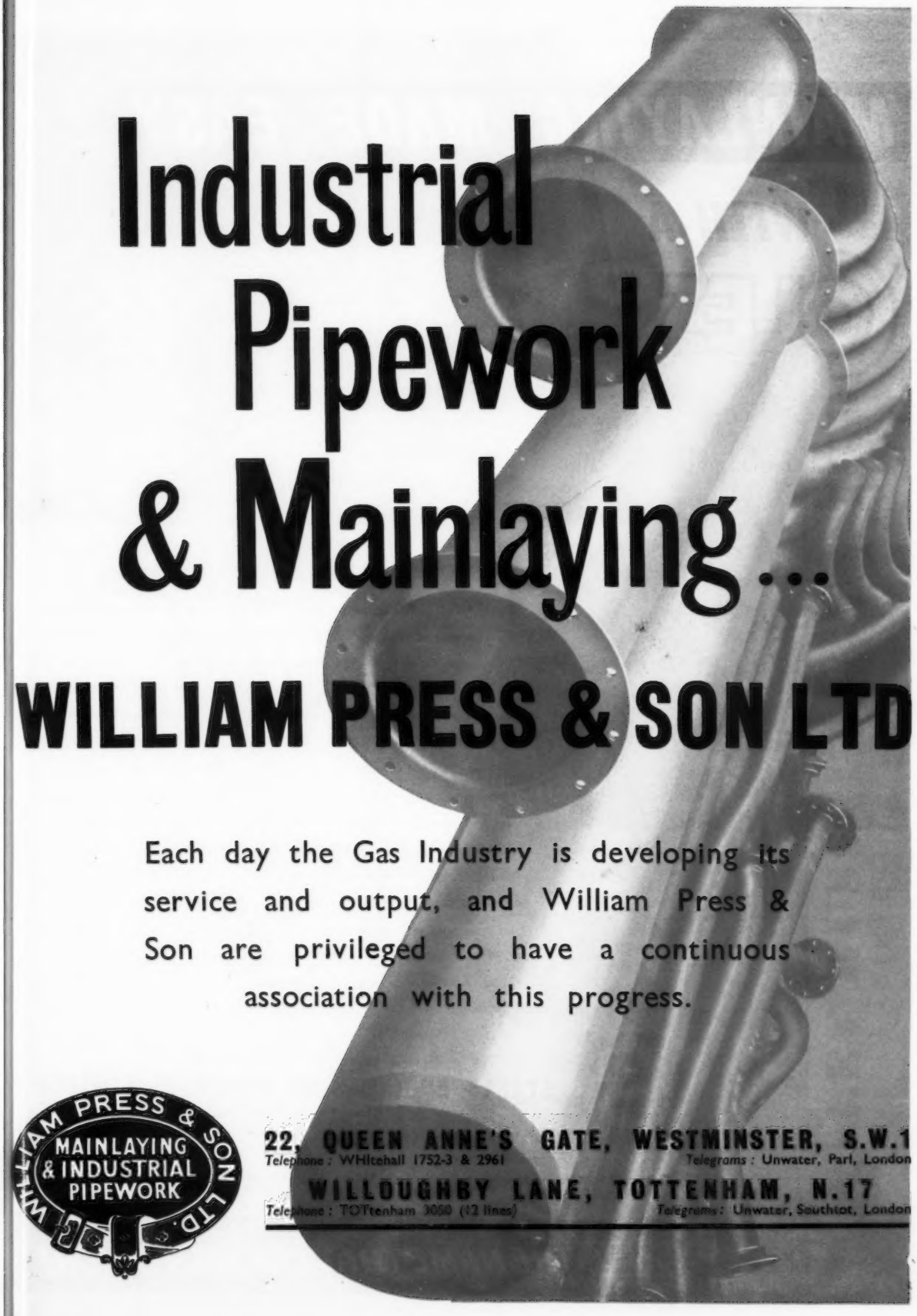

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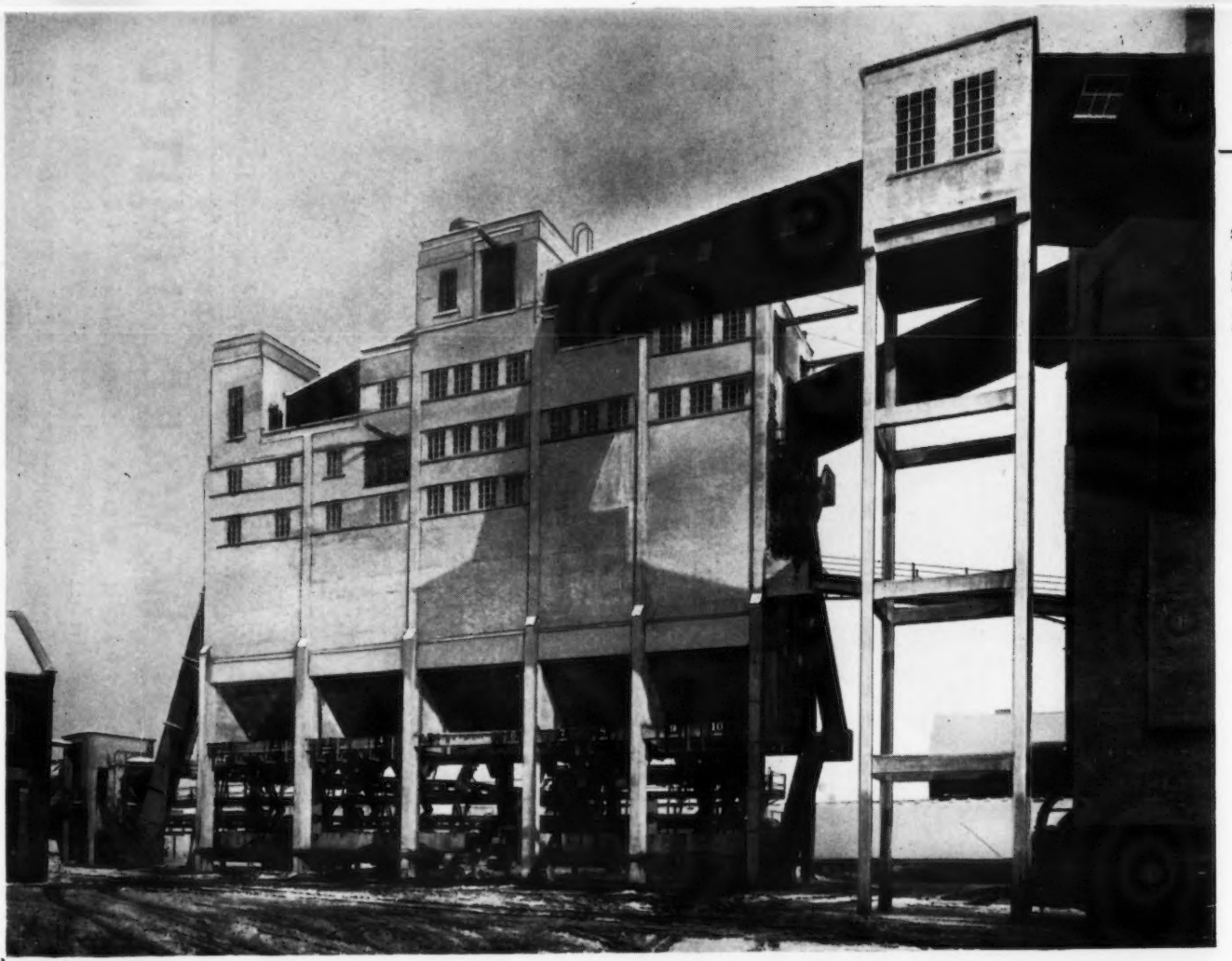

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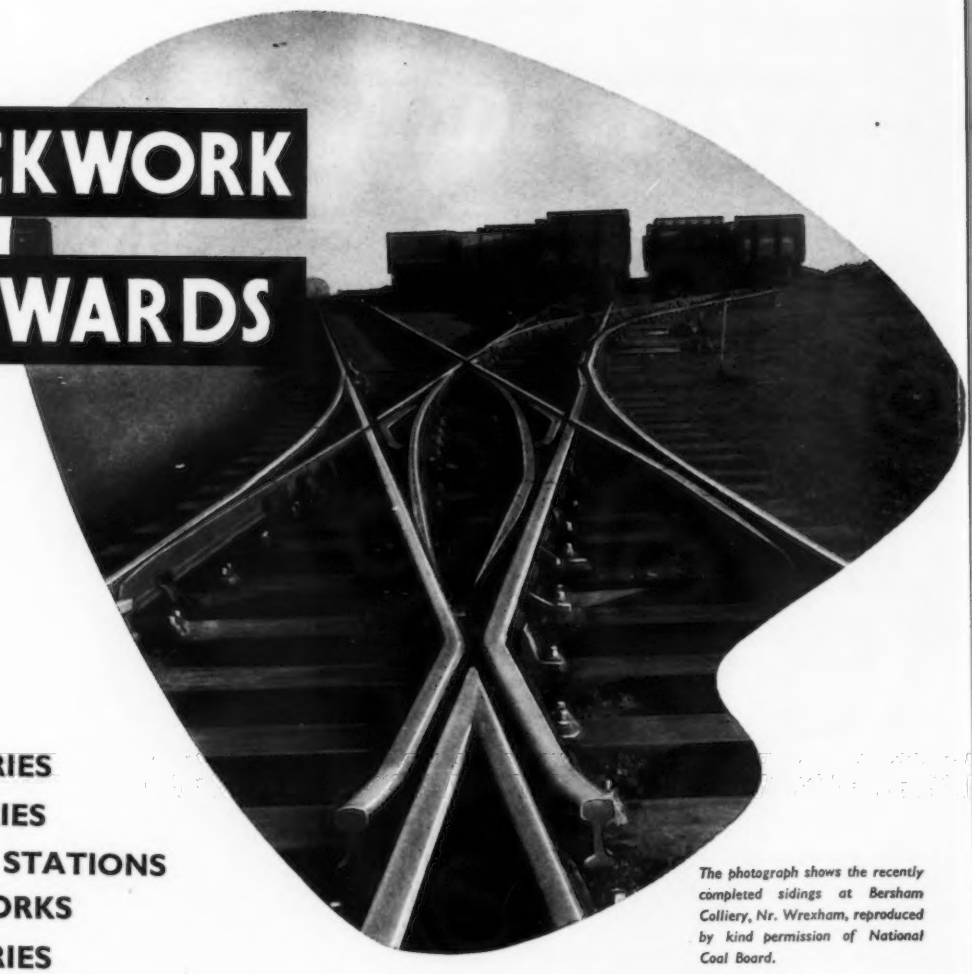

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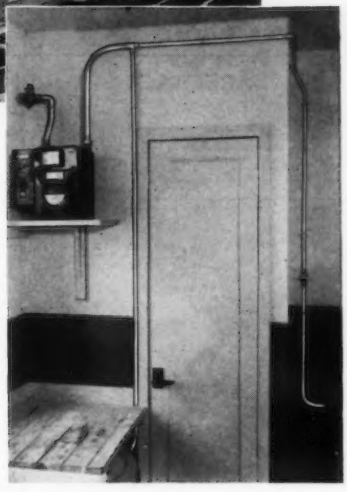

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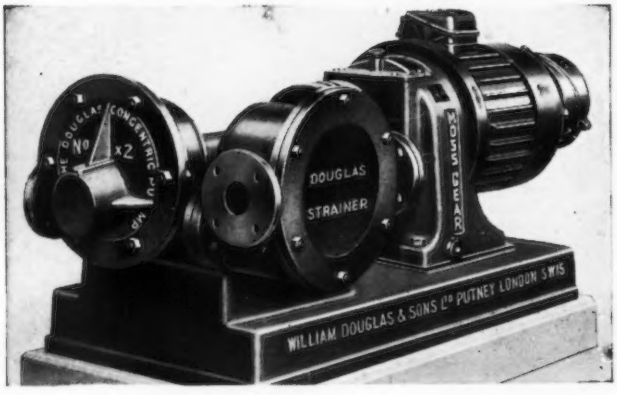

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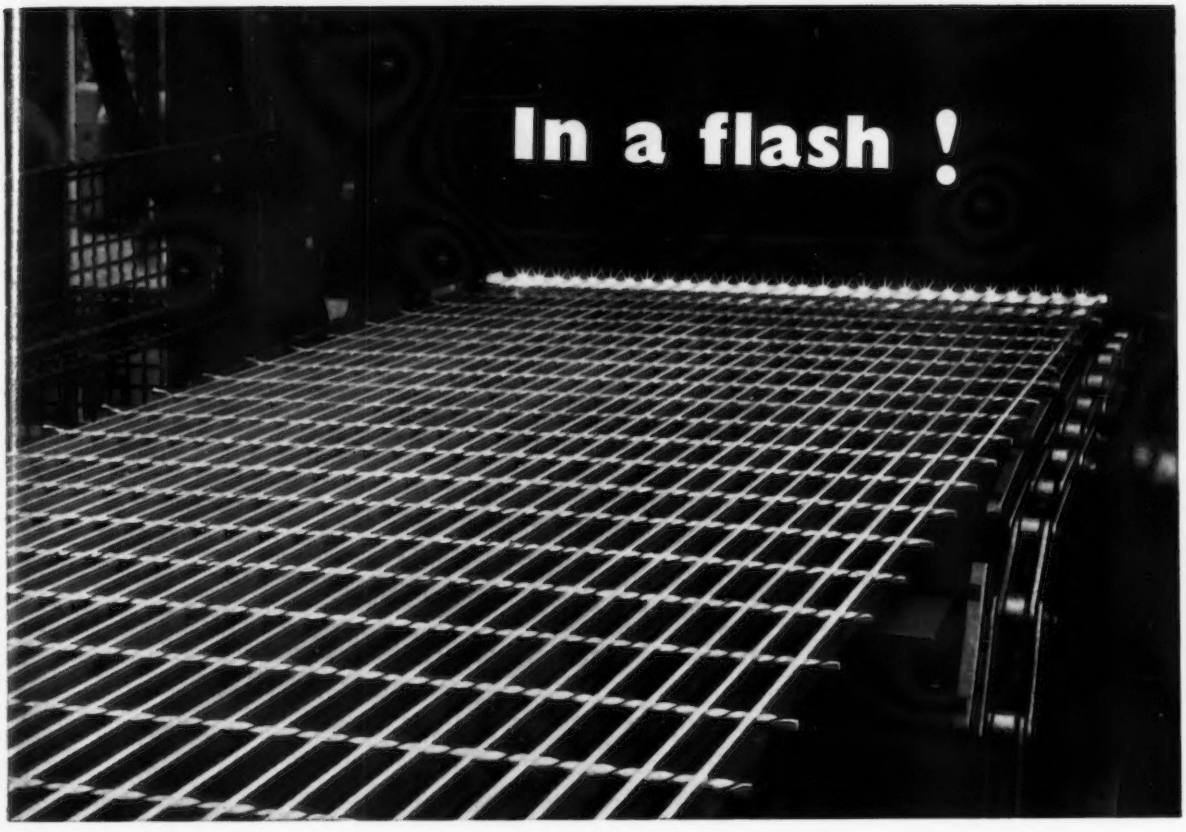

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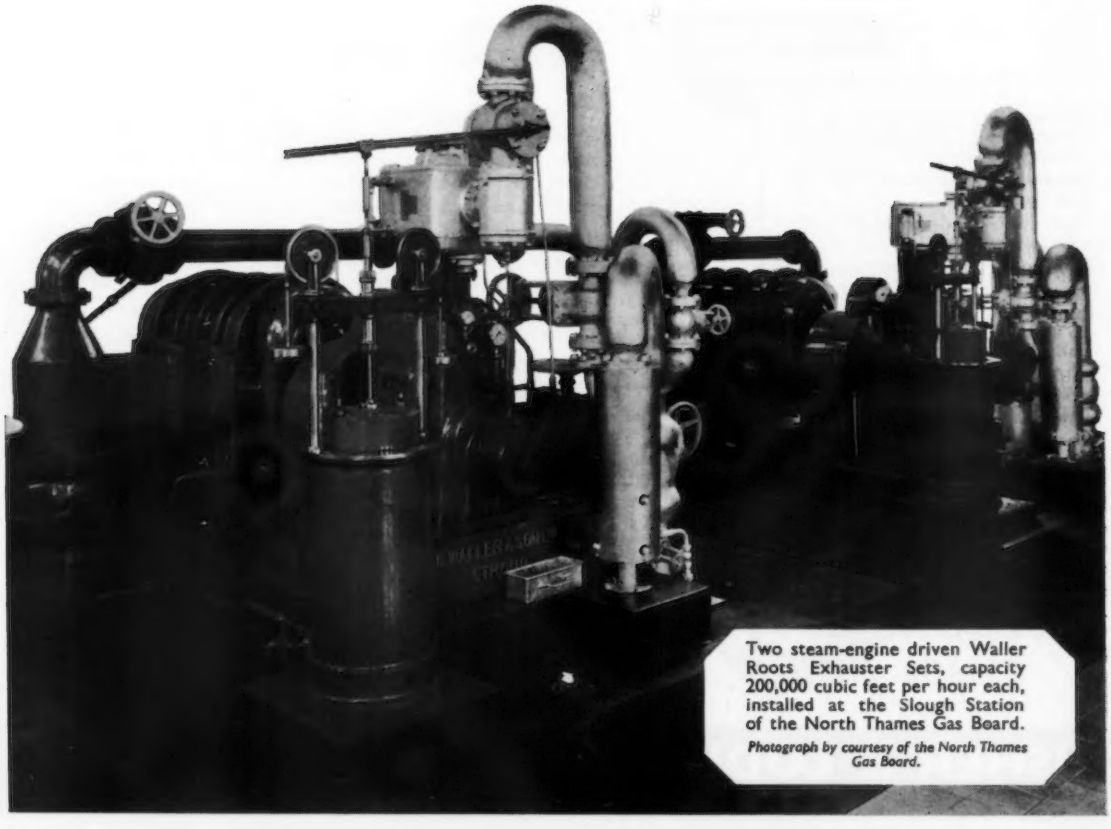

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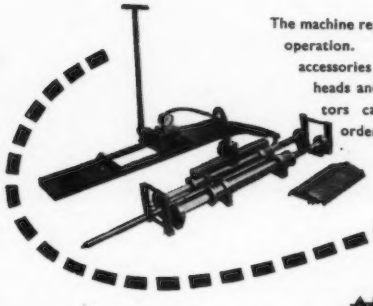

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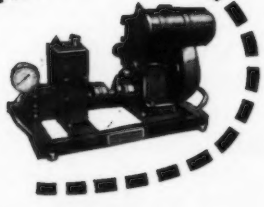

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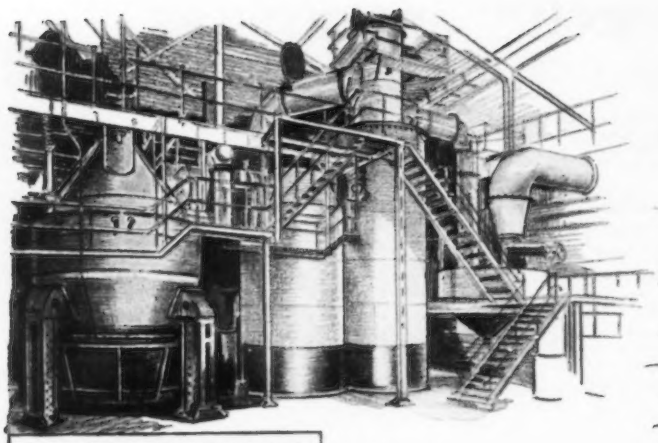

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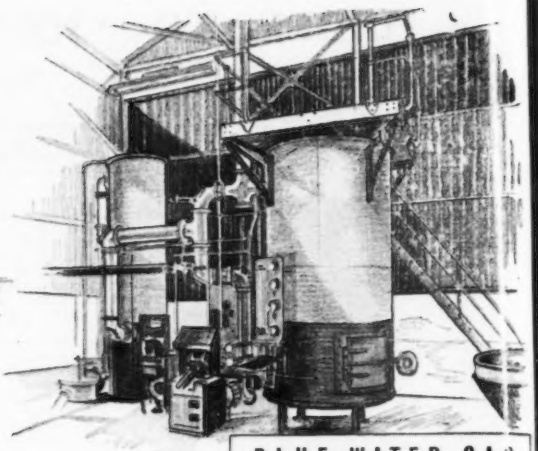

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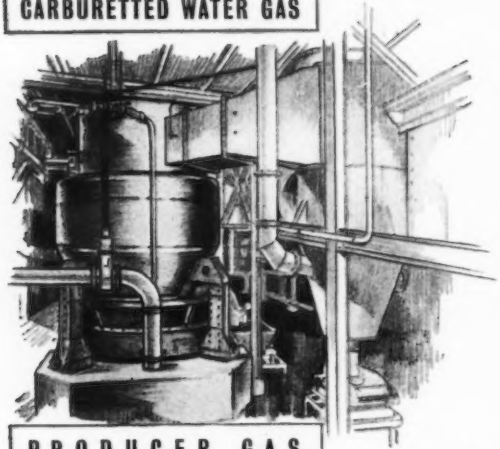

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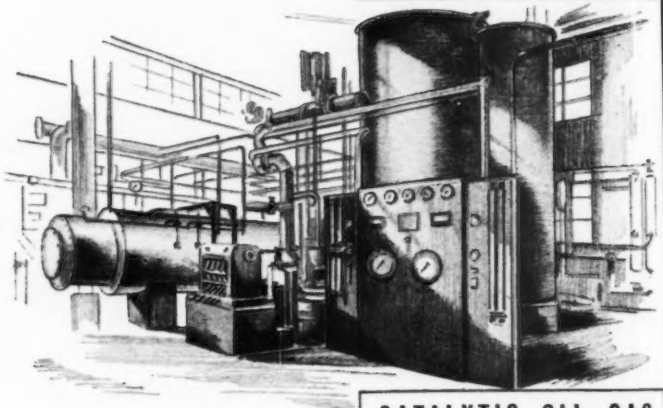

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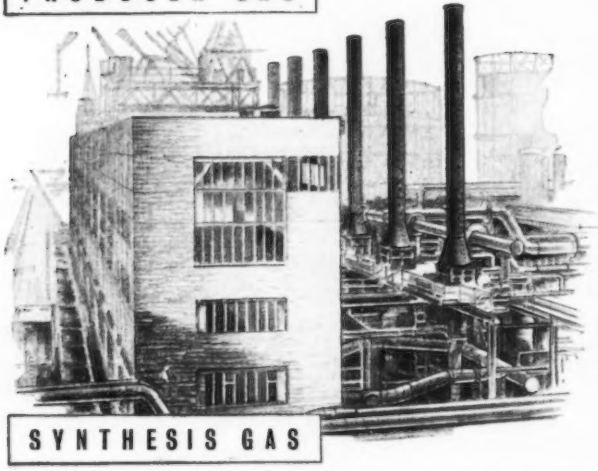

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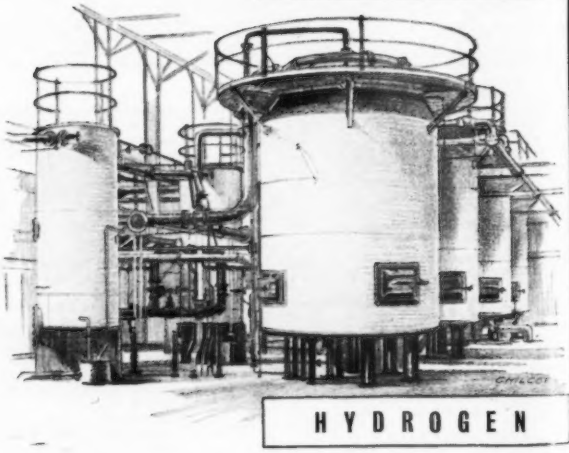

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107TH YEAR

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EDITOR: Trevor G. Williams, A.M.I.Mech.E., Assoc.Inst.Gas E., M.Inst.F.

DEPUTY EDITOR: Arthur C. Cross

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PUBLISHERS' NOTICE, SEE MARCH 16, 1955

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Gas Journal

VOLUME 281. No. 4790. MARCH 23, 1955. 107th YEAR

Increased Resources for Research

TWELVE months ago we noticed in the annual report of the Department of Scientific and Industrial Research for the year 1952-53 a more cheerful note than had been apparent for some years. The report for 1953-54 has now been published, and in it the Advisory Council again expresses a buoyant optimism in its recommendations for using the increased resources made available to the Department under the Five Year Plan. Estimates approved by Parliament for the financial year 1954-55 made provision for an increase in net expenditure by the Department from £5,688,831 to £6,267,210. They provided £91,500 more for annual and capital grants to research associations expected to fall due for payment during the year, and £373,933 more for the maintenance and extension of the work of the Department's own research establishments, including the cost of increasing the number of staff from 3,882 to 4,022, an increase of 200, of whom about 50 would be industrial staff. An important task in the year under review was to study the needs of the various branches of the Department's work in the light of conditions today, and to advise where the increased effort provided for in the plan is most urgently needed; in particular, how the increases of about 150 non-industrial staff per annum, with about one-third that number of industrial staff, should be distributed as they became available. The need for a total increase of 1,000 over five years, and its objects, were established by the post-war plans of which an account was given in the report for 1947-48, but in the years which have since elapsed new needs have arisen and new circumstances have come to bear. Most pressing was an interim decision on staff for the current year, the broad effect of which was to distribute rather more than two-thirds of the total among the five research laboratories, including the Fuel Research Station, most urgently in need.

A changing, not a static, situation is being dealt with, and the Advisory Council is constantly reviewing the relative importance of work already in hand and new proposals. It has accepted the Five Year Plan, 'not regarding it as an arbitrary dole of resources to be applied to the Department's work, but as an acceptable current assessment of the share of Government expenditure and of the country's scientific manpower to be devoted to this purpose.' Since the dissolution of the Gas Research Board (whose work is now the responsibility of the Gas Council) the gas industry has not been so concerned with the detailed aims, objects, and achievements of the D.S.I.R., but there are still many aspects of its work which affect the industry in one way or another. We refer to fuel, coal, coke, cast iron, iron and steel, non-ferrous metals, refractories, scientific instruments, and coal tar research. Of the Fuel Research Station, the Council says the present premises at Greenwich are old and unsatisfactory. In spite of the establishment of new organizations the demands on the Fuel Research Station are heavy and difficult to meet satisfactorily. 'We have no doubts of the urgent need of a new station,' continues the report, 'but it must be planned on the basis of a clearly defined policy. In our view the presence of various research organizations in the fuel field in no way reduces the necessity for the station to maintain its position as a national centre for the study of fuel problems.'

Not only has the number of members of B.C.U.R.A. continued to increase as the Association's researches become better known in industry, but some member-firms have increased their subscriptions in recognition of the value of the work. Some major examples of collaboration with members are recorded in the report. The British Coke Research Association reports extension of field work involving large-scale tests on a blast furnace and at a foundry in co-operation with members. Scientific instrument research is constantly growing in importance, and a brief reference to the British Scientific Instrument Research Association mentions the forthcoming exhibition of instruments which have been designed over the past few years. The research programme of the Coal Tar Research Association has continued to be based on the needs of its sponsoring industry as formulated and defined by the research committee and the advisory panels. The report is a long one running to some 322 pages, and well repays careful study.

The terms of grant to research associations normally are reviewed every five years. During 1953-54 the Advisory Council recommended new terms of grant to ten associations. The overall effect was to increase slightly the maximum amount of Government support which they can receive but to require them to raise substantially more industrial income to qualify for it. An innovation is reported in maintenance allowances to post-graduate students in engineering. Graduates

in engineering, even if likely to embark on a career in research, should acquire practical experience in industry, but when they have acquired this they can earn considerably more than the maintenance allowances normally payable by the Department for training in research. To offset this deterrent, post-graduate students in engineering above a certain age may be awarded grants at higher rates. Copies of the report (Command No. 9386) are obtainable from the Stationery Office at 9s. (by post 9s. 4d.).

Prosperity Prospect

THE March issue of *Focus*, the North Western Gas Board's publication for the information of its own employees, says 1955 was the first post-war year to be ushered in by forecasts of sustained prosperity on both sides of the Atlantic, and proceeds to discuss what justification there is for the forecasts of steadily rising prosperity, and what they imply for the gas industry. If the present expectations of long-term progress are justified and we have, in fact, hit upon a system of economic organization which is at once sufficiently stable in its monetary framework and sufficiently flexible in its detailed operation to bring about a doubling of the standard of living in a generation, then, as *Focus* says, the nation will need more fuel. It has ben suggested that the doubling of national wealth would require approximately a doubling of fuel supplies, but figures for the years since 1929 indicate that the rise in fuel supplies has been much smaller than the rise in national wealth. In the United States national wealth increased by about 80% between 1929 and 1950, while fuel consumption rose by 42%. In Great Britain the national wealth probably increased by about 45% in the same period, and fuel consumption by about 19%. Requirements of coal, as against other fuels, would probably be even less than these figures suggest. Between 1929 and 1950 solid fuel consumption in the United States actually fell by 14% owing to the increase in natural gas and oil supplies, and in Britain there was an increase of only 12%, not much more than a quarter of the rise in national wealth.

On the basis of these figures it would seem that an annual rise in coal supplies of just over 1%, which was the actual rate maintained in Britain between 1948 and 1954, might well suffice to support the annual rise of about 3% in national wealth required to double living standards in a generation. It is possible that even this rate of coal output expansion may prove to be excessive. Although fuel shortage has been a constant threat to Britain's economy in the years since 1947, it is urged that there is no foundation for fear that lack of fuel will prove a brake on the advance of national wealth. The explanation is simply that the recurrent threat of winter shortage has not been due to an excessive rate of advance of national wealth, but to Government control of coal prices at a level where winter demand exceeds the supply. In the view of the writer of the review—which is not necessarily to be taken as being endorsed by the Board—there is no case for the continuance of such control now that the main tide of post-war inflation has been checked. Given freedom for coal prices, the fuel industries will not only keep pace with the rise in national living standards, but will make their own contribution by deriving the maximum benefit from limited basic fuel resources. The gas industry in particular could take a much larger share in the domestic fuel market.

Britain, with its 35 mill. tons of coal burnt direct in the domestic grate, is accused of lagging behind the prevailing trend towards the replacement of direct consumption of basic fuels by the use of converted or piped fuels which appears to be a basic long-term trend in domestic heating, not only in the United States, where domestic natural gas supply competes successfully with oil as well as coal, but in the advanced western countries. The report points out that electricity supply has in recent years claimed a disproportionate share of the nation's fuel-conversion resources. Given the requisite freedom, the share of the carbonizing process is likely to move more nearly into line with that of electricity generation. National prosperity and prosperity in fuel will advance together if the fundamental impetus to progress in the restless search for news ways to satisfy our basic needs is given full scope to exert its driving force in a free and competitive market.

STOP THE LEAK

THE popular Press continues to build up its own dramatic picture of gas as one of the chief unhanged murderers of the age. Exercising its full imaginative brilliance and sometimes deploying its entire front pages, this most influential section of the Press continues to look to us for a sensation. The *Daily Mirror* of March 14 greeted its waking public with these opening words: 'In the Street of Frightened Families. "We dare not sleep . . ."' It is fairly safe to assume that lots more streets of families do not sleep so well having read that—and most of them will be losing their rest unnecessarily. However, before looking into the general situation, let us go further into the headline. In Orrell Street, Manchester, the report says, gas is seeping from the mains laid by independent companies a long time ago. 'In the last six months, it has brought death to one man and nearly killed several other people'. The reporter states he was told by Mr. D. P. Welman, Chairman of the North Western Gas Board, that there was no way of finding out the condition of these mains 'until something happened'. In some cases records of the mains laid had not been kept.

The greatest enemy of the gas industry's good public relations is the out-of-date and, we are told, undetectable installation. Modern gas installations are as safe and modern appliances are as near foolproof as can be hoped for. What are damaging to the reputation of gas are the shocking arrangements that are the rusty remnants of a bygone era—home-made rubber tubing connections, the use ot joint meters, leaky and unproved appliances—the latter often used by old people who are least able to look after themselves in the emergencies such menaces cause. Our point is that if a clean sweep could be made of every one of these potentially dangerous arrangements, we would no longer have the problem of pacifying a public scared into prejudices about gas.

What can be done? We have made many suggestions before about mass-checks, because we are aware that the apathy does not exist in the gas industry but largely with the public. We will go further now and say that, in the case of *all* consumers, where they are found to have faulty connections or appliances and where they refuse to have more done than immediate repairs, or where they are not willing to replace unapproved appliances, they should be

warned that their supply will be cut off This is ruthless, but not so ruthless as, for the sake of the load, leaving them unprotected. It is idle to protest that such appliances and such methods as the joint meter cannot be traced. Let us assume that we have a killer in our midst and let us go after him—when he swings for his crimes, we can say that the new generation is without any guilt whatsoever.

In the meantime, we have before us an edition of the *Scotsman* in which a reader has written to advocate the reintroduction of a 'stink' in gas. He says that accidental deaths due to gas poisoning could only be explained on the assumption that the victims were overcome before they were aware that there was an escape of gas. He continues: 'This is due to our present gas having been so "purified" that it has practically no smell. A gas jet on a cooking stove can be put out by a vessel of liquid boiling over, and it is quite a long time before the escape is noticed. Old people, those who have not a keen sense of smell and those suffering from colds, are especially vulnerable. The Scottish Gas Board should take notice of these casualties and reintroduce the "stink" which once made even the minutest leak apparent to everyone in the house'.

In this matter we have to consider the regulations concerning the extraction of hydrogen sulphide. There is, of course, no question of advocating its reintroduction as it is an impurity which not only contaminates the atmosphere but corrodes appliances and their surroundings. In France, where the widespread use of natural gas, with its lack of smell, has called for action, they are introducing small quantities of mercaptans to produce a pungent odour without leaving any harmful deposit. There is no immediately apparent reason why the gas industry in this country should not do the same. In a house full of Sunday morning cooking smells competing strongly for honours against father's paint in the hall, mother shut in solitary glory in the kitchen is not going to notice the mild smell of a blown-out burner when she slams the door on the children. A newcomer, after a stroll in the fresh air, will notice it immediately he comes in but, in our experience, no one in the house will. To sum up, it is imperative to make a whole-hearted and nation-wide search for unsatisfactory gas installations and to eradicate them when they are found; emphasis on a distinct and unmistakeable smell to gas is also most desirable. These two ends achieved, the popular Press will then have more space to devote to Mr. Bevan and Edwardian fashions.

INTERVIEWING WORKERS

METHODS of interviewing workers in order to discover their attitude to their jobs are described by Mr. R. Marriot and Mr. R. A. Denerley, who are associated with the work of an industrial psychology research group at University College, London, in a report published in the current issue of *Occupational Psychology*. In an enquiry into satisfaction and discontent among production workers in industry over 1,600 workers were interviewed in two motor car factories and in six rolling mills and three factories of a large engineering group with a common management. The aim was to ensure that each worker would have time and freedom to express his own viewpoint, and that he would give his views about all the main factors in his job, and not merely those which were uppermost in his thoughts at the time. It was also to be made possible for the man to assess his own attitude and have an opportunity to correct any bias he had previously shown. The interviewer was not to be at liberty to distract the worker by spontaneous and possibly misleading or suggestive quesions, and the interview was not to become merely a list of questions which, by jumping from one subject to another, would tend to produce perfunctory replies. With these aims in view, the discussion with the workers ranged round eight main topics: The actual task performed, hours of work, shift system, amount of wages, payment system, management and their policies, supervision, and workmates. It was felt that within this framework all the main problems could and would be raised. Each topic was to be treated as a separate section of the interview, linked with questions so worded as to switch the discussion smoothly from one to the other. The number of questions was kept to a minimum. For example, in the section concerning the actual task, the interviewer merely asked what was the man's job, how long he had done it, and what he liked and disliked about it. Then the interviewer gave the man a card on which there were five statements from which he was invited to choose the one which best suited his case. They ranged from 'I like my work very much' through varying and more moderate expressions of opinion to 'I dislike my work very much". The interviewer then asked the man to explain his choice. Analysis of the records showed a remarkable consistency in the replies, and the differences among the interviewers were not sufficient to bias the results or their interpretation. Surveys of workers' attitudes are being used increasingly in industry to help in improving human relations.

An experiment to determine how far workers on a conveyor belt hindered output by difference in working speed is the subject of another contribution to the same issue of *Occupational Psychology*, a report by Mr. R. Conrad, a member of the Applied Psychology Research Unit of the Medical Research Council. The problems associated with balancing work on conveyor belt systems, he says, can be obviated by establishing controlled 'queues' or stores of work at each processing point. As long as the work was broken down into processes taking approximately the same time, the average size of these queues and the amount of idle material would tend to be equal and constant.

PERSONALITIES PLEASE

IT is an interesting fact that several industries, our own among them, spend large sums of money on publicity but rigidly refrain from capitalizing on one of the simplest ways to obtain publicity—that is, by establishing personalities. Nobody, we suggest, is interested in what 'an official' said, whether the official be the chairman or the office-boy. As long as he remains a nameless cog in the industrial machine he forfeits all claim to public interest. The all-too-common warning to newspapers, 'don't mention any names, old boy', is equivalent to reducing the publicity value of the statement by 50%.

This thought came to mind while reading the lively and provocative statement by Sir Harold Smith, Chairman of the Gas Council, published in the March 2 issue of the *Daily Sketch*. It would appear that Sir Harold 'is planning a revolution which may affect nearly every home in the land.' In staccato italics comes the punch line: 'Banish the open fire for ever!' The report goes on to explain that Sir Harold wants to teach people the advantages of using gas and coke as fuels, and stresses the benefits to the nation in terms of saving coal and purifying air over our cities. Details are given of new improved heating appliances, and the report is graced by a cheerful photograph of Sir Harold in revolutionary mood.

It is worth mentioning that this report is part of a magnificent two-page spread which deals solely with new developments in gas appliances and their appearance at the Ideal Home Exhibition. This is a model of how gas publicity can be put over in national newspapers and, coming back to our original point, it emphasizes the value of an interesting statement by a personality. We would like to see more of it. Let Gas Council and area board officials be given a publicity build-up, and let us forget petty jealousies in the knowledge that this is the way to make the voice of gas heard in the land.

Personal

MR. W. OLIVER KIRKWOOD, General Manager of the Sunderland Division of the Northern Gas Board, has been appointed a Justice of the Peace for the County Borough of Sunderland.

MR. G. M. WELLS and MR. I. G. HOPKINSON have been appointed Directors of Hopkinsons, Ltd., manufacturers of safety boiler mountings and valves, as from March 17, 1955. Mr. Wells joined the Company in 1934 and has held the position of London Manager since 1939; Mr. Hopkinson joined the Company in 1938 and has been Works Manager since 1947.

MR. W. S. GOOCH, Controller of Services with the North Thames Gas Board, ended a long and distinguished career in the gas industry with his retirement this month. He joined the former Brentford Gas Company as long ago as 1911. Since 1949, Mr. Gooch has held the position of Controller of Services, a post which has carried ultimate responsibility for the Board's building and property maintenance department, the meter, stove and transport departments, and up to two years ago, the estate department. As announced in our columns previously, he has been succeeded in this post by Mr. J. M. Grammer, formerly the Board's Stores Buyer. For the first thirty years of his service, Mr. Gooch was concerned with gas distribution. It was with that department of the Brentford Company that he started 44 years ago, becoming after eight years Assistant to their Distributing Engineer. In 1926, on the amalgamation with the Gas Light and Coke Company, he was made Divisional Mains Superintendent. In 1937, Mr. Gooch became Divisional Distribution Engineer with responsibility for the areas previously covered by the old Brentford and Harrow Companies.

A wider range of responsibility, including commercial matters, came with Mr. Gooch's appointment as Western Divisional Manager in 1941. An appointment, two years later, as the Gas Light and Coke Company's Labour Manager, brought him finally to Kensington, and in 1945 he became their first Staff Controller. His appointment as the North Thames Gas Board's Controller of Services was among those announced on nationalisation of the gas industry in 1949. A holder of the Military Cross, which was awarded to him after the Battle of Arras, Mr. Gooch was on active service from 1914-19, first with the Royal Fusiliers and then with the Machine Gun Corps to which he was seconded after being commissioned in the Middlesex Regiment. One of Mr. Gooch's present recreations is golf, and he is a member and past captain of Strawberry Hill G.C., one of the oldest clubs in Middlesex.

Obituary

MR. GEORGE CLARK, O.B.E., O.ST.J., J.P., for many years Chairman and Managing Director of the Bryan Donkin Co., Ltd., died on March 10 at the age of 94. In November, 1950, he was presented with a bronze plaque in recognition of his life of service to the Bryan Donkin Co. before a representative gathering of staff and workmen. The plaque, which was placed in the vestibule of the offices at Chesterfield, recorded that Mr. Clark joined the Company in 1893. He was Managing Director from 1908 and Chairman from 1938 until 1949. Earlier in 1950 Mr. Clark had retired from the post of Managing Director of British Furnaces, Ltd., which he had held since the Company was formed in 1921, and of Chairman, which he had held since 1936, but he retained his seat on the Board and continued to act for some time in a consultative capacity. Mr. Clark was for a long time an Alderman of the Chesterfield Council and was at one time Mayor. For a period of 31 years he was Chairman of the Chesterfield Gas Committee and was a well-known member of the British Commercial Gas Association. He received the O.B.E. on New Year's Day, 1949, and a few days later he was entertained by his fellow Directors to a luncheon in celebration of the 88th birthday, at which he was presented with his portrait in oils. An accompanying address recorded that it was in recognition of his constant efforts extending over nearly 56 years, with good wishes and an expression of hope that it would revive pleasant memories of a happy relationship formed and retained over those many years between him and the Board, shareholders, staff, and workpeople.

Correspondence

COKE EXPERIMENTS IN 1930

Dear Sir,

I am grateful to Sir Harold Smith for correcting in your issue of February 16, an understatement of which I am reported guilty in my contribution to the discussion of the Beaver Report at a meeting of the London and Southern Section of the Institution of Gas Engineers on February 1. Sir Harold rightly points out that when, in the Tottenham trials of 1930, running a water gas generator with coke made from clean coal, clinkering was only necessary after 48 hours' gas making, as against every 8 hours with coke carbonized from uncleaned coal.

This difference—due to the clean coke containing only 3% of ash—was only one of a number of advantages. Not only was the quantity of clinker as low as 1.2% of the coke used, but it was entirely devoid of combustible matter, while the clinker from ordinary coke was more than six times greater in quantity, and retained 15% of unused carbon. The complete utilization of the carbon was one factor to account for the great increase in gas and therm production per hour, amounting to nearly 40%.

I venture to suggest that gas engineers who had not yet entered the industry 25 years ago, might do well to familiarize themselves with the facts given in my paper on 'Clean Coal in the Gas Industry' submitted to the Institution of Gas Engineers in 1931, and also to Sir Harold Smith's Presidential Address to the Southern Association of Gas Engineers and Managers in the same year. The adoption of the clean coal policy by the gas industry then urged would go far to meet the recommendations of the Beaver Committee for the extended production of coke of improved quality, greater ease of ignition, higher reactivity and considerably lower sulphur content per therm, as compared with the corresponding properties of gas coke now regarded as normal.

Yours faithfully,
R. LESSING.

3, Thorney Court,
Palace Gate, London, W.8.

Diary

March 25.—MANCHESTER AND NORTH OF ENGLAND SECTIONS, I.G.E.: Joint visit to Tingley Gasworks, followed by Centenary Dinner of Robert Dempster & Sons, Ltd., Elland, at Queen's Hotel, Leeds.

March 25.—WALES G.C.C.: Guildhall, Swansea, 2.15 p.m.

March 26.—WESTERN JUNIORS: Works visit and paper by R. Miller (W. J. Jenkins & Co., Ltd.). Bude.

March 29.—NATIONAL INDUSTRIAL FUEL EFFICIENCY SERVICE and COMBUSTION ENGINEERING ASSOCIATION: Conference on 'Fuel Efficiency Pays' at National Factory Equipment Exhibition, Earls Court, 10.30 a.m.

March 31.—MIDLAND JUNIORS: President's Day at Wolverhampton.

March 31.—NORTH THAMES G.C.C.: Kent Room, Caxton Hall, Westminster, 2.30 p.m.

April 1.—LONDON JUNIORS: 'Oil Gas,' W. J. Walters, 178, Edgware Road. London, W.2. 6.30 p.m.

April 2.—MANCHESTER JUNIORS: Visit to Lostock Gasworks, Preston. 'Crude Tar—Preparation for Sale,' L. V. Mayoh.

April 5.—MIDLAND JUNIORS: 'Gas Central Heating and Hot Water,' W. Walling. Birmingham.

April 5.—SOUTH EASTERN G.C.C.: Caxton Hall, Westminster, S.W.1. 11 a.m.

April 9.—SCOTTISH JUNIORS (WESTERN DISTRICT: President's Day visit to Perth Gasworks.

April 14.—WALES AND MON. JUNIORS (SOUTH): Annual General Meeting. Porthcawl.

April 16.—SCOTTISH JUNIORS (EASTERN): Visit to the Dunkeld undertaking. Combined paper.

April 16.—LONDON JUNIORS: Visit to Kensal Green Works.

Gasholder Development and Design*

By W. R. GARRETT, A.M.I.C.E., A.M.I.STRUCT.E.†

THE main purpose of gasholders is for the storage of gas in order to overcome difficulties due to the varying rates of production and demand, and conventional types fulfill the requirements by storing the gas at low pressure, i.e., approximately 6 to 16 in. W.G. Gas can also be stored in pressure vessels, but the high capital cost of the storage vessel plus high running cost for compressors can only be justified in certain special cases. A sphere is the natural shape for a pressure vessel as it is only in this design that the stresses due to pressure are at a minimum. Despite the apparent advantages of a sphere over other shapes the horizontal cylinder with dished or semi-spherical ends, generally, provides the cheapest method of obtaining high pressure storage. Underground storage is the logical step for the future, and investigations in this respect are being actively pursued by the gas industry.

Both column and spirally-guided gasholders require a tank in which to work, and apart from total height of finished holder, it is immaterial whether the tank is above or below ground level. Cast iron, brick, stone and wrought iron tanks served a very useful purpose until more suitable materials, concrete and steel, became available. Apart from the use of portland cement mortar, the first major use of concrete for constructing a gasholder tank was in 1872 for a tank 152 ft. 6 in. diameter by 39 ft. 6 in. deep. This was a "composite tank" consisting of a 9 in. brick facing with a concrete backing. Header courses 1½ bricks thick were used every seventh course to bond the facing bricks into the concrete, and puddle clay backing was used behind the concrete to ensure a watertight construction. The first large all-concrete tank was built in 1875 and was 184 ft. diameter by 47 ft. deep. No backing clay was used and on filling with water some five to six cracks developed. The reason for the cracks was correctly diagnosed as insufficient consolidation of the earth backing, and in consequence nearly all subsequent underground tanks have incorporated a small percentage of steel reinforcement for the upper few feet. Reinforced concrete underground gasholder tanks became popular on the Continent about 1885. The first reinforced concrete tank constructed above ground level was built in America in 1905, and several partially buried examples have been built in this country. A small prestressed concrete gasholder tank above ground has recently been completed at Cromer. Underground concrete tanks are, generally, dearer than steel tanks with the necessary foundation, and, today, unless height restrictions are imposed by town and country planning, or other factors are involved, economics dictate steel tanks above ground.

While the design of steel tanks to withstand the fluid contents is an extremely easy matter, this is not the case with a buried tank constructed in brick or concrete. In brick and puddled clay tanks, the clay holds the water and the porous wall has only to be of sufficient strength to support the clay and act as a retaining wall, i.e., the brickwork is in compression and is not subject to tensile stresses. On the other hand a concrete or brick tank internally rendered is subject to tension when filled with water and only subject to compression when empty. In the latter case, an accurate estimation of the earth backing is of prime importance for an economic design, and variation of the subterranean water pressure should not be overlooked. Where ground conditions are such that a partially buried tank is advisable, reinforced concrete with the working stress for steel limited to 12,000 lb. per sq. in. and an allowable stress on the composite section limited to 175 lb. per sq. in. appears to produce a satisfactory design, but prestressed concrete is undoubtedly the present-day answer to this problem.

There are virtually no restrictions on the size of steel tank that can now be erected. The largest steel tank in this country is that built at Sheffield in 1938 for an 8 mill. cu.ft. capacity spiral gasholder in which the bottom tier of tank sides is 2 in. thick and has a joint efficiency of 93.8%. The tank is about 250 ft. diameter by 45 ft. 9 in. deep. The minimum thickness of plate for a riveted or welded tank is usually restricted to ¼ in. or $\frac{5}{16}$ in. for the upper tiers and bottom plates. The tendency to pare down the thickness of tank sides by taking the pressure on a tier of side plates some 6 in. to one third up the depth of the tier is to be deprecated, especially if the working stress is also high. Fig. 1 indicates a graphical solution for determination of thickness of side plates for a tank 113 ft. diameter by 30 ft. 3 in. deep, designed for a working stress of 7 tons per sq. in. The stress at the tank bottom is calculated (in this particular case 3.95 tons per sq. in.) and extended proportionately up to 7 tons per sq. in. A second scale can now be constructed so that the 7 tons per sq. in. coincides with a 1 in. thick plate, i.e., representing 100% joint efficiency. New scales can be formed to give any desired efficiency, and these sub-divided will indicate the thickness of plate required to fall outside the stress diagram. It will be observed that had a 90% joint efficiency been adopted for the lower three tiers of plates these could have been decreased in thickness from $\frac{7}{8}$ in., ¾ in.

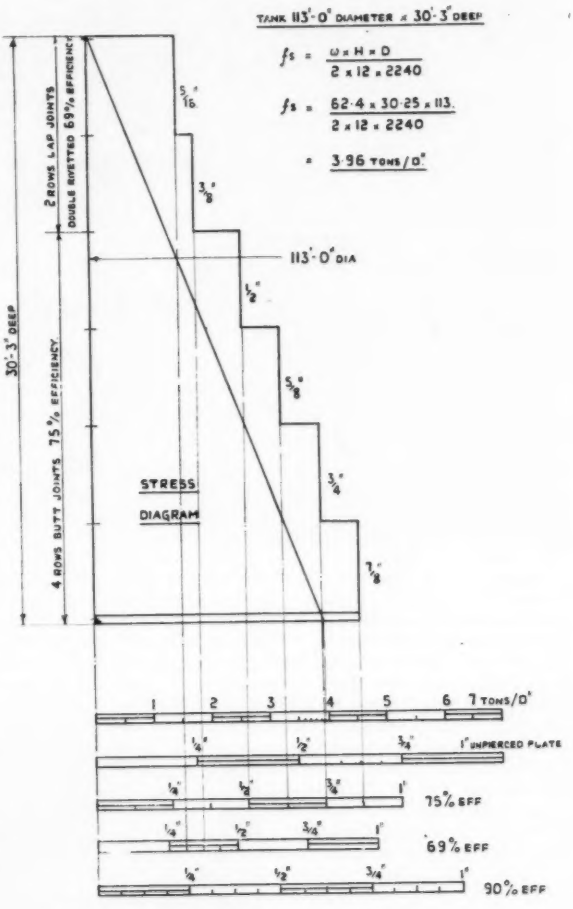

Fig. 1. Graphical solution of thickness for tank plates.

* From a paper read before the Institution of Structural Engineers in London, on January 13, 1955.
† Constructional Engineer, Northern Gas Board.

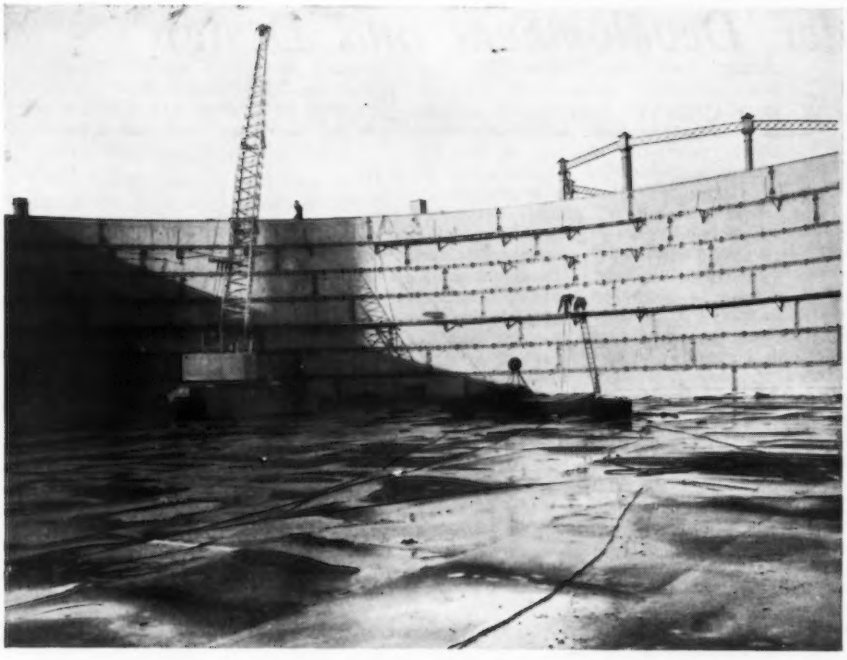

Fig. 2. Portable crane used in erection of tank plates.

and $\frac{5}{8}$ in. to $\frac{11}{16}$ in., $\frac{13}{32}$ in. and $\frac{1}{2}$ in. respectively. Joint efficiencies for double riveted lap joints approaching 75% are used on the thinner plates, but for anything in excess, inside and outside butt covers are required, and joint efficiencies in excess of 90% are obtained.

In the past, the efficiency of joints in butt welded tanks has normally been taken as 85%, but with the possibilities of notch brittleness occurring, particularly in the thicker plates, it appears that much more thought must be given to both the material used and the design. It appears that full penetration butt welds are desirable for the vertical seams, but whether a similar type of joint is desirable for the circumferential seams is doubtful. Lapped circumferential seams with comparatively light fillet welds may well prove the best form of construction. Present prices indicate little difference between riveted and welded tanks, but if for the latter special materials and X-ray examination are essential to avoid a notch brittle structure, then riveted tanks even with the attendant difficulties of obtaining good riveters may well be the ultimate answer. The only other alternative is to reconsider the numerous designs which have been adopted in the past. One such scheme, patented in 1897, avoids the rapid increase of thickness required for the lower tier of plates by encompassing a tank of uniform plate thickness with a slightly larger tank of uniform thickness, but of half the weight, the annular space so formed being filled with water. Tanks using buckled, bulged or radius walls all avoid the use of thick bottom tier plates.

Gasholder tanks are similar in all respects to tanks required for fluid storage requirements, except that the former have rest blocks for supporting the lifts when at rest, and a chequer plate balcony which provides access and gives rigidity to the upper edge of the tank. In column guided gasholders, the tanks are provided with vertical channel guide sections, and in spiral holders, supports are arranged to transfer the load from the spiral carriages to ground level. Gas inlet and outlet pipes are usually arranged some distance apart to ensure a certain degree of mixing of the gas. With tanks below ground there is little chance of flooding the district mains with water, but, in the case of steel tanks, this possibility is removed by looping the gas mains above tank water level prior to their entry into the inlet and outlet pipes.

The load imposed on the foundations of a holder mainly consists of the weight of water contained in the tank, and a reinforced concrete slab to bridge any local weakness is often all that is required. Should the sub-soil be incapable of carrying the superimposed load, piles at about 6 ft. to 7 ft. centres with beams and slabbing are provided for overcoming the difficulty.

Steel tanks of both welded and riveted design are normally erected and tested with the first tier of side plates clear of the ground, and subsequently lowered after testing. To erect the tank on its foundation and thus omit the underside fillet joint on the lapped bottom plates and finally test by a vacuum box has its advantages, but it is doubtful whether this is an advisable form of construction for gasholders. Erection of tank side plates is usually accomplished by a crane, or travelling derrick, working on a rail track fixed to the bottom plates, although the pneumatic tyred portable crane appears to do this job as efficiently (Fig. 2).

The crown sheets of the bell are arranged as a segment of a sphere, and as these are supported by the gas when the holder is inflated, no trussing is required. However, for erection purposes, and when the holder is at rest, some support

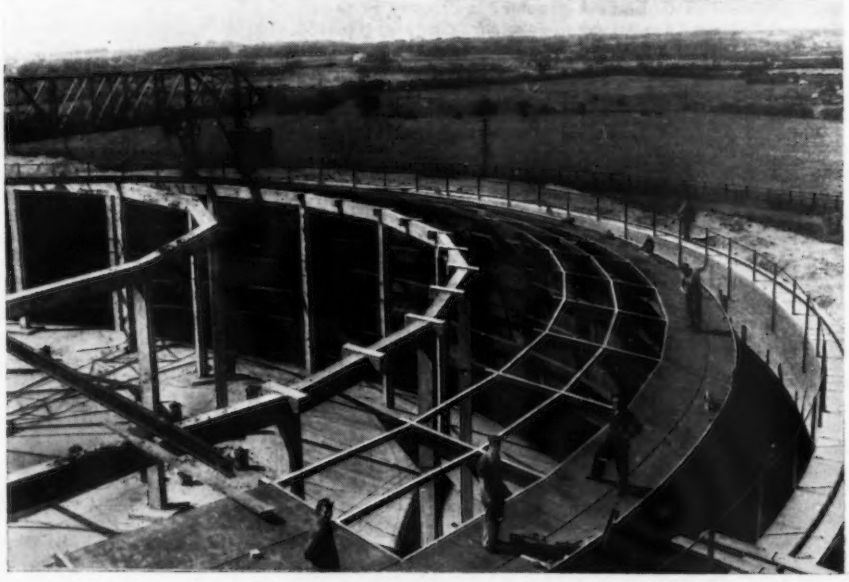

Fig. 3. Tank Crown supporting frame.

is necessary. In the case of an underground tank, which is almost invariably built with a dumpling, this can be most economically arranged as a fixed timber, steel or reinforced concrete structure (Fig. 3), but for a steel tank, where the supporting columns are long, a truss framing with a centre support is the usual solution. If the holder is required to throw a heavy pressure, a trussed crown framing adds weight to the bell and thus serves two functions. Crown framing is designed to carry the dead weight of top sheets, snow and erection loads.

In the case of guide framed gasholders, the wind load on the side of the bell is transmitted to the framework by the guide rollers. Various arrangements of guide rollers, i.e., tangential, skew, etc., in theory, give a better stress distribution to the framework, but in actual practice it is wise to rely only on the radial rollers. Fig. 4 shows a guide framed gasholder in course of erection and three of the set of four roller carriages erected. Diagonal bracing is usually provided for the vertical standards with horizontal girders to give lateral stiffness. An important feature, for this type of holder, is to supply a deep wind girder at the top of the framing to ensure circularity of the upper ends of the cantilever standards.

Fig. 4. Radial rollers for a column-guided gasholder.

The bell of the spirally guided holder is similar, in many respects, to that of its column guided counterpart. The main difference is the application of the external guide rails which brace the lift in a diagonal direction. These guide rails vary for the large holders from a 70 lb. per yard B.S. flat bottom rail section to special sections of 55, 41 and 40 lb. per yard for the smaller holders. Generally, the maximum pitch of the rails is about 30 ft., and rarely exceeds the depth of the lift. The pitch is determined by the working load on the carriages, and, wherever possible, it is usual to arrange the number to be a multiple of four. Thus, for a medium-sized four lift holder of, say, 2 mill. cu.ft. capacity, the number of spiral rails might be 16, 20, 24 and 32 for the inner, second, third and outer lifts respectively. The inner lift is usually provided with two vertical stays to each spiral rail, but the number of stays to the remaining lifts is dependent on design requirements, and is usually just under two per rail. There is a wide variation in the design of guide carriages, but, generally, the two wheel variety with a tread diameter of 10 in. is fairly common. The wheels are usually cast steel or mild steel. The axle diameters vary from 2 in. up to 4 in. diameter, and these may be ordinary mild steel or carbon steel.

Apart from the self weight or dead load the principal loading for a gasholder is that produced by wind and snow. The latter, when evenly distributed over the crown sheets, merely increases the gas pressure and the stress in the top curb, and does not affect the framing. However, to safeguard against the distinct possibility of uneven snow distribution over the crown it is wise to allow for such a contingency. A reasonable snow allowance is 5 lb. per sq. in., acting over one quarter of the crown area on the leeward side. The wind pressure increases with height above ground level, but the most practicable course is to use some uniform figure. Most authorities assume wind values of 40 lb. per sq. ft., but this, for such a large structure, appears excessive, and 32 lb. per sq. ft. would seem to be more reasonable. Reduction in wind pressure due to shape has been variously estimated from 41% to 57%, but again 50% is reasonable. Maximum working stresses are those usually adopted for steel structures.

In column-guided gasholders, it is assumed that only the radial carriages on the leeward side that are less than 60° with the diection of the wind are effective (Fig. 5). The load carried on each carriage is proportional to the distance from the neutral axis, i.e., cosine of respective angle with the direction of wind, and the resistance is equal to the distance from the neutral axis. Thus, the relative effective resistance of the carriages will be the distance from the neutral axis squared, or cosine squared. In addition, the top carriages of the inner lift are assumed to take the whole eccentric load caused by snow (Fig. 5). Thus, the total wind load on each lift is proportioned to the effectiveness of its carriages, and a series of shear loads on the framing is obtained. A small additional shear load is added to cover the wind on the framing. The framing acts as a hollow cylindrical cantilever. The horizontal component of the wind which each bay receives is proportioned to the cosine of the angle that the bay makes with the direction of wind (see windward side of diagram Fig. 5) and, in addition, its resistance is proportioned to the cosine of the angle of the bay in relation to the wind. With the maximum loads on any bay of framing the members can be determined (Fig. 5). To avoid excessive deflection of the whole framework large gusset plates should be used, and it is wise to limit the stress in diagonal members to about five tons per sq. in. Column-guided gasholders are rarely built today, but by adopting welding, and a rigid frame design, it is possible to save some 30% of the weight of the framing of a normal commercial design.

The cost of a spirally-guided gasholder is generally less than that of the column-guided type, and this, combined with its proved reliability, has resulted in the comparatively rapid increase in the number of spiral holders now in service. The design principles are more readily appreciated if actual figures are taken, and in the following example the design of a one mill. cu.ft. capacity holder will be briefly investigated. The lift sizes for this capacity will be:

	Diameter		Depth	Number of Spirals
Inner lift	117 ft. 9 in.	×	30 ft. 0 in.	12
Middle lift	120 ft. 4 in.	×	30 ft. 0 in.	16
Outer lift	122 ft. 11 in.	×	30 ft. 0 in.	24

and these will be accommodated in a steel tank 125 ft. 6 in. diameter by 31 ft. 0 in. deep (Fig. 6).

With the exception of the two carriages which occur on the neutral axis it is assumed that all carriages, by taking either upward or downward loads, contribute to the stability of the holder. Their effectiveness is proportional to the

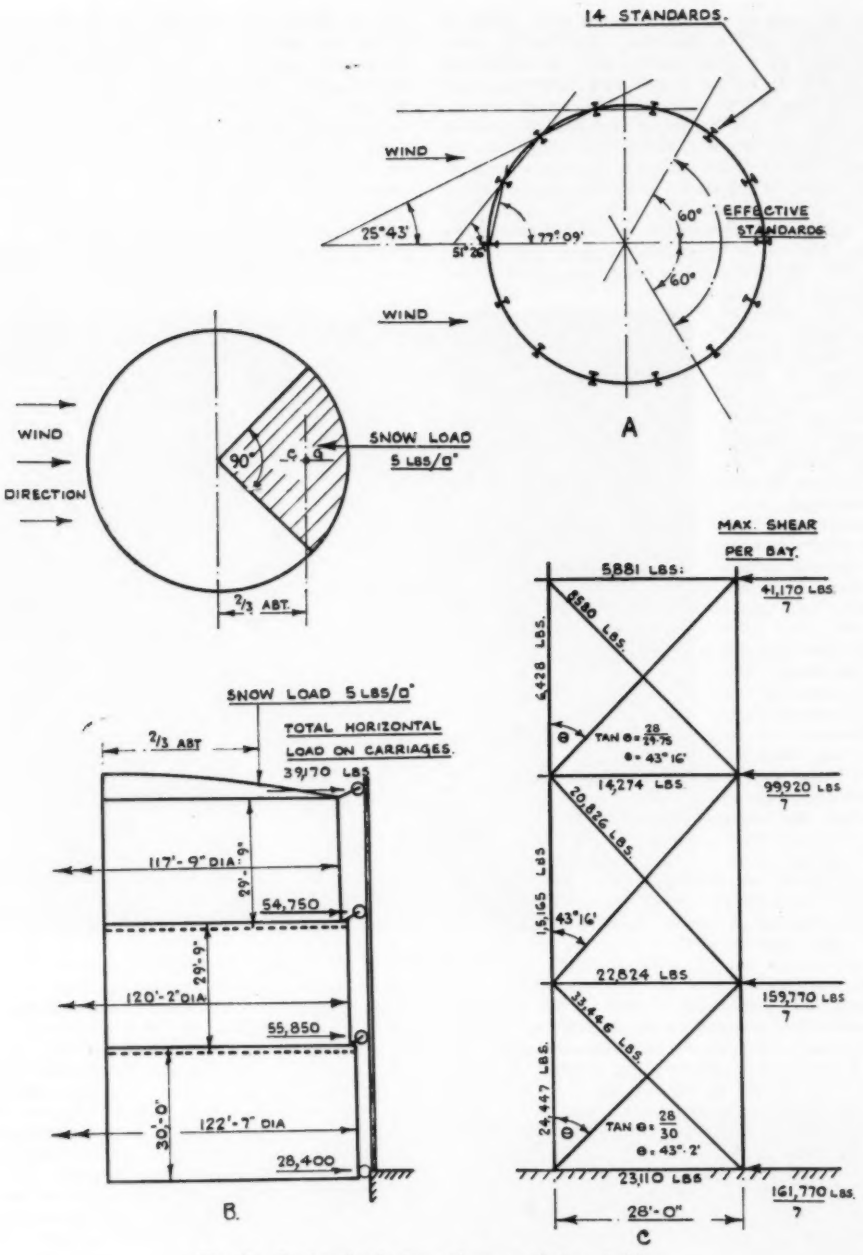

Fig. 5. Design loads for column-guided gasholders.

distance from the neutral axis, i.e., cosines of respective angle to the wind direction and their resistance will be equal to their distance from the neutral axis. Thus, the relative effective resistance of the carriages will be the distance from the neutral axis squared, *i.e.*, cosine squared. Assuming the holder is fully inflated to give maximum load conditions on the 24 carriages situated on the tank balcony the relative effective resistance of the carriages will be as shown in Table I:—

TABLE I

Angle	Number of Rollers	Cosine of Angle	Number of Rollers × Cosine² of Angle
0°00′	2	1.00	2.00
15°00′	4	0.9659	3.731
30°00′	4	0.8660	3.000
45°00′	4	0.7071	2.000
60°00′	4	0.5000	1.000
75°00′	4	0.2588	0.269
90°00′	2	0.0000	0.000
			12.000

This means that although there are 24 carriages the maximum vertical load carried by any one is equal to one twelfth of the total load or if there are x carriages the maximum load on any one is the total load divided by $0.5x$.

The total vertical load on the carriages will be derived from (*a*) wind on side, (*b*) snow on crown.

(*a*) Taking the horizontal wind load of 32 lb. per sq. ft. on a normal surface or 16 lb. on the diametrical projection of a cylindrical surface, the equivalent total vertical load in tons on the tank carriages will be:

$$\frac{\text{Mean dia.} \times \text{total height} \times \text{wind pressure} \times \text{lever arm}}{2240 \times \text{radius of outer lift}}$$

$$= \frac{120.33 \times 92 \times 16 \times 46}{2240 \times 61.46} = 59.2 \text{ tons.}$$

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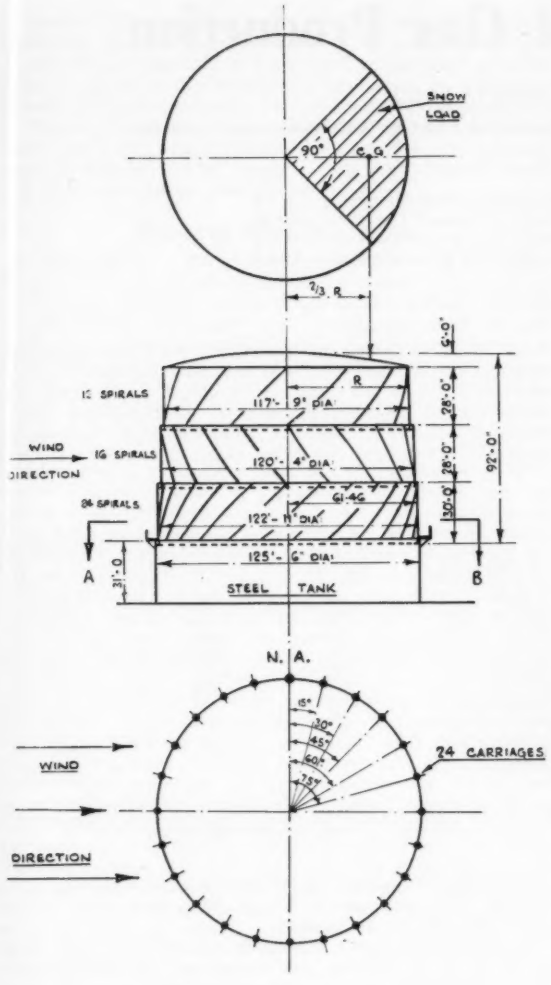

Fig. 6. Design loads for spirally-guided gasholders.

(*b*) It will be assumed that a snow load of 5 lb. per sq. ft. will act on one-fourth of the area of the crown and this, to give maximum bending moment, will be positioned on the leeward side of the holder. The centre of gravity of the snow load acts at a point approximately two-thirds of the distance from the centre of the crown to its outer edge.

Snow load = (Area of crown × 5 lb.)/4

Vertical load on carriages (from snow)

$$= \frac{\text{Area of crown} \times 5}{4 \times 2240} \times \frac{\text{Two-thirds radius of inner lift}}{\text{radius of outer lift}}$$

$$= \frac{10890 \times 5}{4 \times 2240} \times \frac{2 \times 58.87}{3 \times 61.46}$$

$$= 3.9 \text{ tons.}$$

Total maximum vertical load on tank carriages

$$= 59.2 + 3.9 = 63.1 \text{ tons.}$$

$$\text{Maximum carriage load} = \frac{63.1}{12} = 5.26 \text{ tons.}$$

The vertical load of 5.26 tons is resisted by one of the two carriage rollers (Fig. 7), and owing to the 45° inclination of the spiral rails the resultant roller load is 5.26 × 1.414 = 7.44 tons. The bending moment on the axle is divided by the section modulus in order to determine the maximum stress on the axle.

The carriage loads on the top of the outer lift and top of the middle lift are obtained in a similar manner to the above, the overturning moment due to wind being calculated when two lifts or one lift respectively are inflated.

Maximum stress occurs in the crown and side sheeting when the holder is fully inflated; the former is designed as a portion of a sphere subject to internal gas pressure and the latter as a cylinder subject to a similar force. The theoretical thickness of crown sheets is approximately double that of the sides. The top curb is designed to resist the pull in the top sheets, the weight of the side sheets, the internal gas pressure and the external wind pressure. The inner lift stays are designed to take the weight of the crown framing and side sheets, plus snow when the holder is at rest. The stays for the remaining lifts take a proportion of the maximum carriage loads depending on number in relation to carriages and also have to be capable of carrying the wind load as a beam. The cup and dip rings have to take the compressive wind load but practical requirements are such that the working stress in this particular portion of a holder is usually fairly low.

Many interesting details of design occur in this type of structure, but it is felt that sufficient information has been given to appreciate the general principles and problems which are met in gasholder construction.

Acknowledgments

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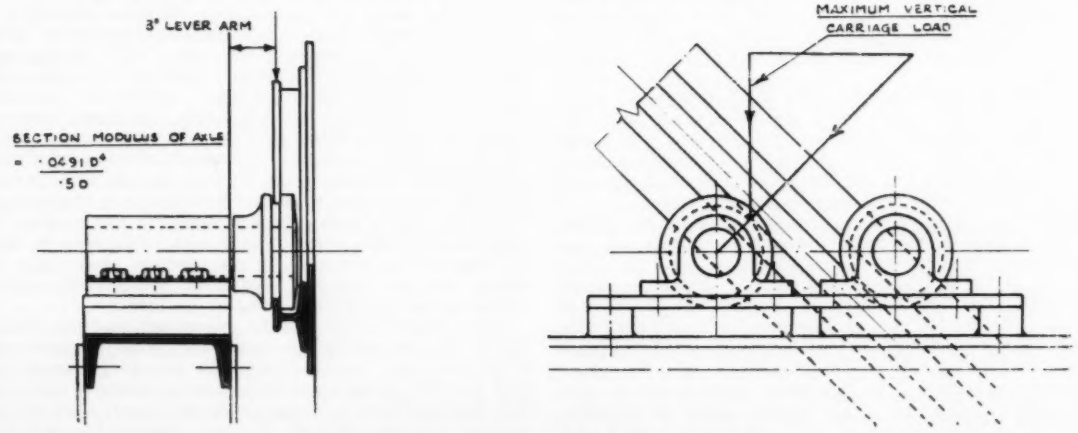

Fig. 7. Diagram showing load on spiral carriage.

Future Methods of Gas Production

By HENRY F. H. JONES, M.B.E.,
(Junior Vice-President, Institution of Gas Engineers, and Deputy Chairman, Gas Council)

This address was given at a joint (Eastern and Western) meeting of the Scottish Junior Gas Association at Glasgow on March 5, presided over by Mr. G. Royden (President, Western District) and attended by Mr. D. Elgin (President, Eastern District) and senior officers of the Scottish Gas Board.

THE methods which will be used for the production of gas in years to come must be a subject of interest and concern to all those engaged in the gas industry. A question commonly asked is, 'is the gas industry to be a one-fuel or two-fuel industry,' but you will find that I do not give a complete answer to this question, for the answer depends on a number of unknown quantities, including the availability of coal and oil in future years.

In considering the subject for my address I have had two points especially in mind. First, that when considering lines of future development, particularly in relation to research, it is important not to make too many assumptions based upon pre-conceived ideas, nor to take too much for granted. Second, that nowhere in the Gas Act is there a definition or interpretation of the meaning of the word gas. Not until one reaches the 3rd Schedule of the Act does one discover that gas is expected to have a calorific value and that it is therefore a form of fuel. On the other hand, it does appear from various sections of the Act that carbonization is assumed to be an important part of the gas industry's activities and by implication, therefore, that coke-oven gas is a subject of concern to the gas industry.

The Type of Gas to be Supplied

I think it worth while to consider briefly whether, if a gas supply industry did not exist at present we would wish to supply the kind of gas which today is known as town gas. Let us assume that civilization as we know it exists, but there is no town-gas supply. It has been suggested that a great deal of waste of fuel and unnecessary effort is being devoted to carting coal, coke and oil products about the country and delivering them to people's homes; that the use of electricity has been developed to a point at which its further provision is becoming difficult even allowing for atomic power-stations, and that delivery of solid fuel to domestic premises, hotels, shops and factories and removal of ash represents a considerable waste of effort, part of which could be avoided. We may assume:—

(1) That coke-ovens operate solely to provide coke for steelworks and that the gas which they produce is used in these works and that some coke-oven owners have sold surplus gas to adjacent factory owners for industrial use;

(2) that in the process of extracting oil in different parts of the world vast quantities of natural gas are released, some of which is used in factories, but much of which is wasted;

(3) that the suggestion has been made that much better efficiency of fuel utilization, a great saving of transport, and greatly increased convenience for domestic and other consumers of fuel could be secured if a suitable fuel gas were manufactured and distributed in pipes to the homes, offices, establishments and factories of the nation.

One would have to consider the best sort of gas for utilization, particularly in the home, methods of distribution and measurement, and possible sources of gas. I have set out in Table I a list of some constituents which might be considered for a fuel gas, showing the calorific value in B.Th.U. per cu.ft. and also in therms per ton. I have also included the calorific value in therms per ton of coal, carbon and some liquid fuels.

While considering this matter of calorific value in respect of volume and weight, it may be noted, so as to give a sense of proportion, that a ton of air occupies about 29,000 cu.ft., and a pound of air about 13 cu.ft. A ton of typical coal gas produced by high temperature carbonization will occupy about 70,000 cu.ft. and the gas made from a ton of coal will weigh about 400 lb. You will note that the gases included in Table I are carbon monoxide, hydrogen and hydrocarbons which are, of course, compounds of hydrogen and carbon. Combustible gases composed of other substances, for example sulphuretted hydrogen, would be eliminated because it seems

TABLE I.

Substance	Formula	Calorific value (gross) B.Th.U. per cu. ft. (saturated)	Calorific value (gross) Therms per ton
Hydrogen	H_2	318	1,365
Methane	CH_4	995	536
Ethane	C_2H_6	1,731	498
Propane	C_3H_8	2,465	483
Butane	C_4H_{10}	3,204	477
Ethylene	C_2H_4	1,613	497
Acetylene	C_2H_2	1,456	484
Benzene	C_6H_6	3,658	405
Carbon monoxide	CO	317	97.9
Carbon (amorphous)		—	323
Fuel oil		—	421
Gas oil		—	430
Petrol		—	466
Coal			280/320

(Values taken or calculated from 'Handbook of Chemistry and Physics' by Hodgman, Published by the Chemical Rubber Publishing Co., U.S.A.)

obvious that the gases supplied would have to burn to give virtually water and carbon dioxide only, these being normal constituents of the atmosphere.

Hydrogen and carbon monoxide are attractive fuels from the point of view of easy combustion and high flame velocity. From the point of view of transmission and storage, mixtures of methane and higher hydrocarbons would be better because of the larger heat content per cu.ft. of gas. Table I shows the high calorific value of hydrogen in therms per ton which makes it an attractive fuel, but some doubts would arise about a fuel gas composed entirely of hydrogen because of the large weight of water produced in combustion. On the other hand it might be concluded that the gas supplied should have a specific gravity a good deal less than that of air. on the grounds that this would avoid the accumulation of pockets of gas near the floor or in cellars of buildings. Methane, in spite of a rather low flame velocity, would be expected to make a good fuel gas. Methane represents the ultimate achievement of hydrogenation as applied to carbon. No other hydrocarbon contains such a high percentage of hydrogen although the heavier compounds contain more hydrogen in each molecule. Ethane, propane and butane are all possible gases for a town supply, but consideration of density and flame velocity must be taken into account. Consideration might be given to the supply of gases which have been used in small quantities for domestic use such as acetylene and petrol mixed with air. Acetylene is a dangerous gas for use in any process which requires its compression, and mixtures of petrol and air might, unless the air was dried. be expected to give rise to corrosion in steel pipes and fittings. In any case the unsaturated hydrocarbons such as acetylene are of value for chemical synthesis.

There would, of course, be experience to draw upon in the use of coke-oven gas in steelworks and of petroleum gases in oil refineries. It would be known that the gas made from coal by high temperature carbonization makes a very good fuel gas, and that a reasonable degree of variation in composition could be tolerated. It would also quickly be decided that natural gas, principally methane, although not inter-

changeable with coal gas, could also be used with success in suitable equipment. Studies would be made of the use of coal, oil and electricity in houses, offices and other premises so as to ascertain the probable consumption of gas week by week htroughout the year. It would soon be concluded that for cooking, water heating and industrial use, gas would be supplied at a very regular weekly rate, but that superimposed upon this regular rate of supply a very large demand would have to be met during cold weather.

Sources of Production of Gas

A brief survey of the problem of production would show that gas could be manufactured by the carbonization of coal as in a coke-oven, but that this would involve finding a market for the resulting coke, apart from limiting the choice of coal to those types which would produce a saleable coke. Producer gas already made for industrial purposes from coal or coke might be considered, but a gas with such a high proportion of nitrogen would be quite unacceptable for distribution. The range of suitable mixtures being confined to gases consisting of hydrogen, carbon monoxide or hydrocarbons, one would be bound to review sources of hydrogen and sources of carbon and to examine any methods already in use for making gases for industrial purposes, such as for the synthesis of ammonia and of liquid hydrocarbons. One would search for available sources of carbon and hydrogen from which the fuel gas might be manufactured. Oxygen of course could be obtained from the air.

Although one source of carbon could be vegetable matter, the only really large source of carbon, other than the carbon dioxide in the atmosphere, would be found to exist in the 'fossil' fuels such as coal and oil. For a source of hydrogen one could look only to water and would study, or institute research into, methods of converting the fossil fuels into gas by breaking down the large molecules of which they are constituted into smaller molecules and in some cases combining them with the hydrogen and oxygen in steam to give carbon monoxide, hydrogen and hydrocarbon gases. All the processes for the total conversion of coal and oil into gas by combination with water in the form of steam depend upon the splitting of the steam into hydrogen and oxygen, for which heat is needed, and the combination of the resulting products separately or together with the coil or oil to be gasified. Partial conversion into gas could, of course, be achieved by the carbonization of coal or the thermal cracking of oil.

We know that coal can be made to yield up to 70 or 75 therms of gas per ton by carbonization and that half a ton of coke will also be produced. The static processes of carbonization in coke-ovens, horizontal retorts and intermittent vertical chamber ovens all produce a relatively dense coke while the continuous vertical retort produces a coke of lesser density. The carbonization process is only economical if the available supplies of coal are of a type which will enable coke of a satisfactory quality to be made and if remunerative markets exist both for the gas and the coke made.

Petroleum Coke

When considering oil in the context of carbonization it may be remembered that the ultimate product from the distillation of oil is petroleum coke, but it seems unlikely that very large quantities of oil will be carbonized for the purpose of coke production. As a rule oil is too valuable a fuel to be used in this way. The quantities of coal suitable for carbonization available from sources in Great Britain are not precisely known. It has been stated that in ranks from 301 to 600 inclusive 97 mill. tons is produced each year against about 53 mill. tons carbonized, and if coals of rank 700 are considered to be suitable for carbonization another 35 mill. tons can be included. Some of these coals are high in sulphur, others are difficult to clean, but there is no doubt that much coal which is, or which could be made to be, suitable for carbonization is consumed for other purposes. There is, therefore, as is needed if the policy of smokeless air is to be pursued, the possibility of a great extension of the carbonization of coal in this country. At best, however, because the carbonization of coal or oil fails to convert a large proportion of the raw material into gas, it must be right that a gas industry should study and endeavour to perfect processes for the complete conversion of its raw materials into gas, and the various gasification processes are worthy of more detailed study. Some of these processes can be classified as follows:—

Coal/Coke ..	Cyclic	Low pressure
	Continuous	Low pressure
	Continuous	High pressure
Oil ..	Cyclic	Low pressure
	Continuous	Low pressure
	Continuous	High pressure
Examples of each type of process are:—		
Coal/Coke ..	Cyclic Low pressure ..	Water Gas. Blue (or carburetted)
		Gaz Integral Plant
		Tully Plant
	Continuous Low pressure	Producer with air blast.
		Producer with oxygen enriched blast.
	High pressure	Lurgi. High pressure with steam oxygen blast.
Oil ..	Cyclic Low pressure ..	Water Gas. Carburetted (also needs coke).
		O.N.I.A.—G.E.G.I.[1]
		SEGAS.[2]
		Jones
		Hall
	Continuous Low Pressure	Gas Light and Coke[3]

Processes for the gasification of coal and coke depend upon reactions between carbon, oxygen and steam.

1. $C + O_2 \longrightarrow CO_2$
2. $2C + O_2 \longrightarrow 2CO$
3. $C + CO_2 \longrightarrow 2CO$
4. $C + H_2O \longrightarrow H_2 + CO$
5. $CO + H_2O \longrightarrow H_2 + CO_2$[4]

The combination of a ton of carbon with oxygen in the reaction $C + O_2 \longrightarrow 2CO$ yields less than a third of the heat produced in the reaction $2C + 2O_2 \longrightarrow 2CO_2$ which yields 323 therms per ton of carbon. The reaction $C + H_2O$ absorbs a large amount of heat, say, 140 therms per ton of carbon.

In any complete gasification process a balance has to be established whereby the heat released by the reactions $C + O_2 \longrightarrow CO_2$ and $2C + O_2 \longrightarrow 2CO$ is sufficient to provide the necessary heat absorbed by the reaction $C + H_2O \longrightarrow H_2 + CO$, the heat for the distillation and cracking of other constituents, and the heat losses from the vessels.

Gasification processes for the conversion of coal into gas must, unless the coal is of a low volatile type, provide for the recovery of the oils and gases driven off from the coal while it is being heated to the temperature required for the gasification process. Processes in which this object is achieved in a retort are the Tully process and that known as Gaz Integral or G.I. In the Lurgi generator the coal is fed into the generator and raised in temperature by the hot gases from the gasification zone which continuously pass through it.

The reactions which are of interest to us are those relating to the coke or char after it enters the gasification zone, and we find that all the processes for gasifying coal and some of those for gasifying oil have one thing in common and that is that it is not possible to convert a carbonaceous raw material into town gas without discarding some of the raw material. The reason for this is clear. If sufficient heat is to be released in a fuel bed to enable the reaction between carbon and steam to be sustained, some of the carbon present must be burnt to carbon dioxide, and the oxygen required for this reaction must be supplied additional to that contained in the steam. Having discarded the ordinary producer gas process, because of the high nitrogen content of the gas made, the only ways in which the temperature of the fuel bed can be maintained are either by intermittent operation, in which, while air is blown through the bed, the gas produced is discharged, as at the stack valve of a water gas plant, or else oxygen must be fed into the generator with the steam thus enabling continuous gasification to take place. The intermittent principle is applied in normal water gas practice and in the catalytic process for the gasification of oil. The use of oxygen although common in low pressure producers for the production of synthesis gas does not enable a suitable town gas to be made because of the low calorific value of the gas produced. It is a feature of the Lurgi process in which the steam and oxygen are fed to the generator at a pressure of about 20 atms. that, at this pressure, and with the temperatures prevailing in the generator, part of the hydrogen produced in the gasification zone reacts with the carbon in the coal in the upper zones and forms methane so that the gas made is of considerably higher calorific value than that made in low pressure generators. Lurgi gas contains a high percentage of carbon dioxide, but at the pressure of 20 atms. or so there is no difficulty in washing out the excess carbon dioxide with water or other suitable liquid. You will note

that just as in the water gas process some of the carbon in the coal disappears out of the stack valve so in the Lurgi process part of the carbon is washed out of the gas in the form of carbon dioxide.

I have said little about the familiar carburetted water-gas process in which gas oil or, more recently, fuel oil is cracked to enrich blue water gas. The use of oil for enrichment is bound to continue, because oil is in good supply whereas coal and coke are not. If, however, this position altered, methane could be made by the synthesis process developed by the Gas Research Board and used instead of oil for enrichment. Those interested in these gasification processes for making gas from coal or oil can refer to papers presented to the Institution of Gas Engineers by D. Hebden, R. F. Edge and K. W. Foley[1], F. J. Dent[3], Stanier and McKean[2], G. le B. Diamond[4] and D. Hebden[6] and to many other sources. The report of the Gas Productivity Team which visited the United States of America contains much useful information about the gasification of oil of various qualities.

To recapitulate, in all these processes we start with oxygen in air or in purified form, and carbon in coal or oil. In most of the processes steam is also present. We dissociate the steam by reacting it with carbon or carbon compounds, supply the heat by burning some of the raw material with additional oxygen, and then, if we wish to make town gas we throw away part of the carbon in carbon dioxide either in stack gases from water gas or oil gas plants or in the washing of the gas made by the Lurgi process. The efficiency of the processes depends upon the extent to which heat can be conserved, the consumption of oxygen reduced and the percentage of steam converted kept at a high level. As I have already said, the particular feature of the Lurgi process is that part of the hydrogen leaving the gasification zone combines with the carbon in the coal to form methane, thus increasing the calorific value of the final gas made. The formation of methane is an exothermic reaction[4] and so does not require the addition of heat to the reaction zone. In this process as at present operated a large excess of steam has to be present to prevent clinker formation. If the generators can be designed for slagging operation a considerable increase in thermal efficiency will accrue.[4]

The catalytic oil gasification processes whereby oil is cracked in the presence of steam can be applied to the gasification of almost any petroleum oil from heavy residual oil to petrol and can be adapted to convert butane and propane into gases similar in performance to town gas made from coal.[2] Methane arising from coal mines or found as natural gas can only be converted by working at higher temperatures or by using other catalysts.

It seems that, having regard to the present availability of processes and of raw materials (coal, oil, oil-refinery gases, butane, propane and methane), gas of similar type to that now supplied, say 450-500 B.Th.U. per cu.ft. and 0.45 to 0.55 s.g., will be in common use for years to come. If natural gas is found or imported in large quantities some districts may be supplied with almost pure methane, and in any case some small places will be supplied as at present with mixtures of butane or propane and air or blue water gas.

The big question remains. How much of the gas of the future will be made by carbonization and how much by the gasification of coal or oil or the conversion of other gases? This question cannot be answered without knowing how much coal for carbonization will be made available to the gas industry, and how much of the smokeless fuel market, greatly increased by the acceptance in principle by the Government of the Beaver Committee's report, will be met by the gas industry.

I personally believe that the high temperature process of carbonization is the best method for the treatment of suitable carbonization coals by the gas industry, either alone or blended. To produce a good smokeless fuel from a reasonably wide range of coals is well within the capacity of known high temperature processes, and there seems to be no need to leave more than a small proportion of the volatile therms in the coke if it is made from a coal in the middle ranks; that is from coal which is not too strongly caking. Any carbonized fuel must of course be made from coal which is reasonably low in ash. Low temperature processes of carbonization cannot be disregarded, but the gas industry is interested primarily in the supply of gas, and I am very doubtful whether the yield of gas from any low temperature carbonization process is likely to be sufficient to interest the gas industry except as a purchaser of any surplus gas. By normal high temperature carbonization it is possible to obtain from a ton of coal containing, say, 300 therms, 75 therms as gas and 150 therms as coke. From a lower quality of coal carbonized under somewhat different conditions one could expect to secure 65 therms of gas and perhaps 150 to 160 therms of coke. We have, therefore, when considering carbonization by comparison with gasification to consider the manufacture from coal (after allowing for process efficiency, and the yield of byproducts other than coke) of gaseous therms to the extent of one-third of the yield and solid fuel to the extent of two-thirds. Under the gasification process the conversion efficiency is lower, but apart from tar and oils the yield is all gas, and from coal containing 280 therms a ton the yield of gas might be expected to be, say, 160 therms by the water gas type of process working at low pressure and rather more from a high pressure process such as Lurgi. Coal can be used for the gasification process which, because of high ash content or weak caking power, is entirely unsuitable for carbonization so that a wider field of choice of coals is available. The gas made can, of course, be enriched by the use of oil.

Cost of Production

The question of cost is of paramount importance. It is obvious that any process of gasifying coal or oil must result in the production of a therm of gas at a higher cost than that of the coal or oil from which the therm of gas is made because it will require more than one therm of raw material to yield one therm of gas. It is always most dangerous to prophesy, but it seems to me doubtful whether a therm of gas can ever be made in this country by the gasification processes for less than twice the cost of a therm of coal or one and a half times the cost of a therm of oil. At present I should regard both these targets as very difficult to achieve.

When one considers carbonization, however, an entirely new situation arises because the weight of the products, other than gas, far exceeds the weight of the gas and not infrequently the value of the products is also higher than that of the gas. H. D. Greenwood read a paper on January 8, 1953, before a joint meeting of the Institute of Fuel and the Coke Oven Managers' Association, Southern Section.[7] Table III of that paper shows that in the Midlands it was then possible to recover more than the cost of coal by the sale of coke and breeze alone, excluding income from gas, and all the products other than gas were sold for 128% of the cost of the coal. It is difficult to say what the proper ratio should be between the cost of raw coal delivered to a gasworks and the cost of good smokeless fuel prepared for sale at that gasworks. In a paper by J. Burns and L. J. Clark the cost of manufacture of coal gas at riverside works of the North Thames Gas Board[8] is given with prices as at September, 1952. I have extracted some figures from Appendix 2 of the paper and have set them out in Table II (a) of this address, showing the total cost in pence per therm of gas made by three different systems of carbonization and inserting the figures used by the authors, but excluding capital charges. The coke/coal price ratio used in the paper was 1.1 to 1.

In the Report of the Ridley Committee efficiencies are quoted for the use of solid fuel in domestic appliances. Taking the middle range of efficiencies quoted in Table IV on p.23 of the Ridley Report one finds with open fires a ratio of efficiency of roughly 1⅓/1 in favour of coke compared with raw coal. Allowing for the increased cleanliness of coke, a price ratio of 1½/1 might not be considered unreasonable. I thought therefore that it would be interesting to re-calculate the costs on a 1.5/1 ratio of coke/coal prices. In Table II (b) I have shown the result of altering the coke/coal prices ratio from 1.1/1 to 1.5/1 by reducing the price of coal and increasing that of coke and for the purpose of this calculation, which has no particular reference to present day costs, and is intended purely as an arithmetical exercise, I have shown the changes which occur in the cost of gas. The price of coal is reduced by 10s. 1d. per ton and the price of coke is increased by 16s. 11d. a reduction of the order of 2½d. per therm of gas made or 27% is thus brought about by this change. It is a feature of all calculations of the cost of gas made by carbonization that the cost is a residual figure involving differences between

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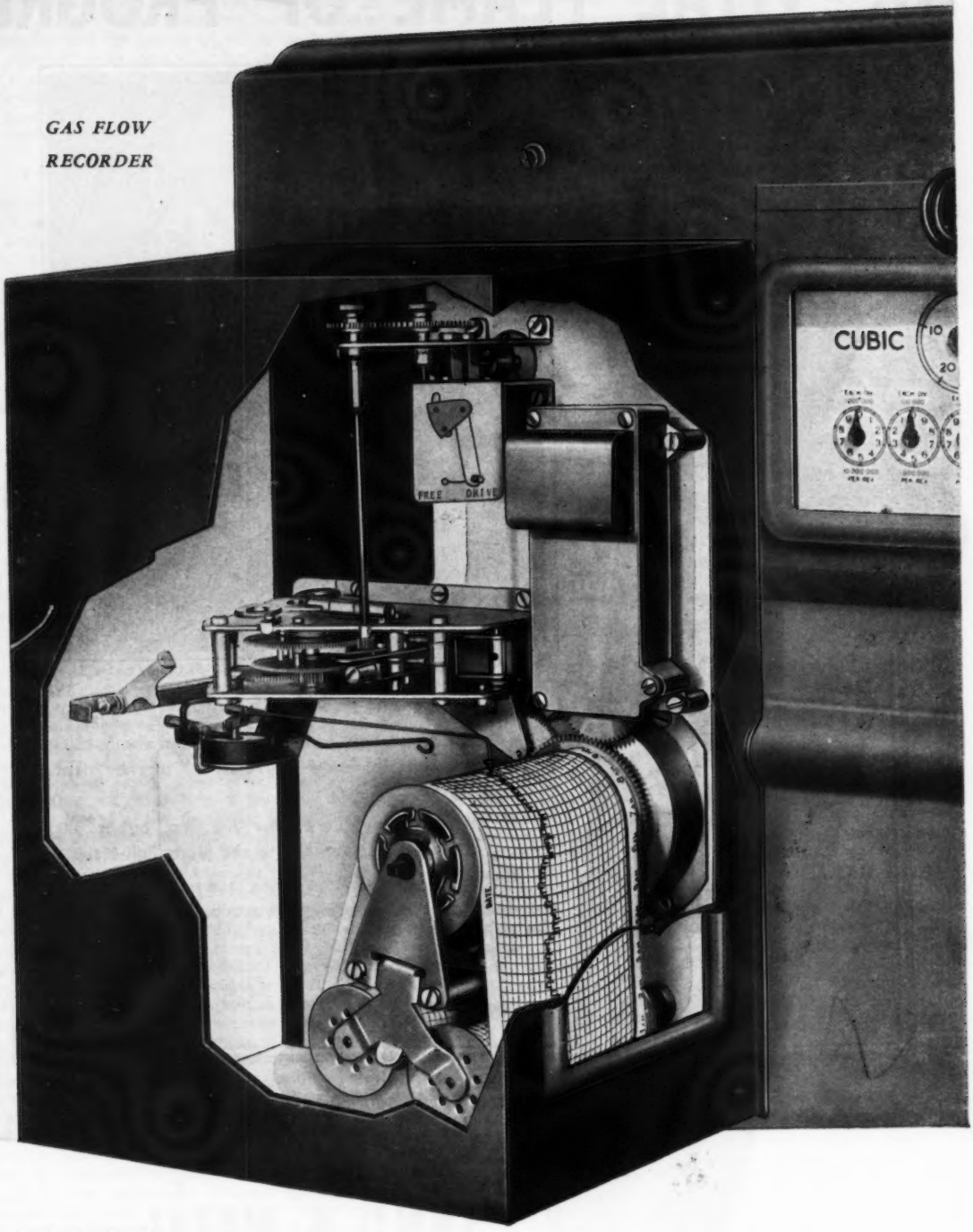

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THE VITAL FLAME OF PROGRESS

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quite large quantities, so that comparatively moderate changes in the cost of coal or in the price of coke can have important effects on the cost of gas. It has often happened in the past, in coke-oven practice, that a coke-oven can be operated at a profit without selling the gas at all. It is probable that this situation may not recur except under most exceptional circumstances, but given a satisfactory coal/coke price ratio it may be expected that gas made by carbonization under conditions of nearly 100% load factor will often prove cheaper than gas made by gasification.

Future Developments

It seems to me that the picture which will develop in the future will show an increased production of coke made from low ash coals, not necessarily of the highest ranks such as are needed for the manufacture of metallurgical coke. The gas from the carbonization of these coals will provide a substantial proportion of the total base-load supplied by the industry and the coke will provide fuel for consumers in smokeless zones. There will, however, be additional requirements for gas beyond that which can be obtained from carbonization of the available supplies of coal and by the production of gas from coal carbonized in coke ovens to make metallurgical coke. These additional supplies will come from methane, either found as natural gas, imported in liquid form or drained from coal mines, and by the use of gas made by the complete gasification of coal and of oil. The availability of coal whether of carbonization quality or otherwise will depend partly on the success of the National Coal Board in increasing supplies and partly on the rate of development of power stations using nuclear fission as a source of heat.

The availability of oil seems likely to increase. Outputs are sufficient to match market requirements, and in this country one leading oil company has recently announced a sales compaign designed to double its sales of fuel oil. Total reserves of oil and natural gas are much lower than those of coal, but industry is interested in fuels available above ground rather than in quantities locked up in the bowels of the earth.

The way in which the various sources of gas production will share the load must depend primarily on the type of coal which is available and the speed with which the use of coke is expanded. The nature of the load on the gas supply industry in the future must also have a bearing on the matter because for meeting peak demands in winter there are only two real alternatives. One is a cheap type of plant for the conversion of coal or oil into gas and the other is the storage of gas underground in sufficient quantities to even out the seasonal load factor. If an important part of the winter space heating load is to be taken by gas, the present load factor, in which the maximum winter demand is roughly twice the minimum demand in summer time, may move towards ratios found in America by the gas industry's Productivity Team who reported a ratio as high as 10/1 in some places.

Plants for the carbonization of coal and plants for the gasification of coal by the Lurgi process require capital expenditure such that the cost of gas produced can only be kept within acceptable limits by all-the-year-round working. The manufacture of gas from coal by either of these processes must therefore continue throughout the greater part of the year. Plants for gasifying coal by the water gas process with oil enrichment or for the direct gasification of oil by the catalytic process require a lower capital outlay for a given gas making capacity and these types of plant can be used economically to meet part of the winter load. If there is a worsening of the ratio between the winter and summer demand for gas the use of cheap peak load plant for the gasification of heavy oil, light spirit and liquified petroleum gases will become more important. It may be that it will be difficult to balance against seasonal demands a gas supply system based upon:—

(1) Carbonization to meet the nation's requirements of smokeless fuel;
(2) gasification of coal of low quality by the Lurgi process or by low pressure processes such as G.I. or Tully;
(3) catalytic gasification of oil;
(4) gasification of oil and light hydrocarbons in cheap peak load plant;
(5) natural gas either indigenous or imported.

Methods which may be available for the improvement of flexibility are the use of town gas for heating carbonizing plant, the storage of town gas underground on a scale which would even out seasonal fluctuations, and the use of gas in the summer months for a synthesis process, the liquid products of which would be sold or stored for gasification in cheap equipment during the winter.

We can never be sure what the future will bring. I believe that the methods of gas production used in the future must:—

(1) Give the widest possible choice of source materials;
(2) include the carbonization process developed to the highest possible level of efficiency, including the lowest consumption of heat combined with the highest throughput per unit of plant. The use of the carrier gas or Rochdale process may become important;
(3) include gasification processes of the highest possible thermal efficiency for the conversion of coal, oil and heavy hydrocarbon gases into town gas.

Mr. D. Elgin (President, Eastern District) proposed a vote of thanks to **Mr. Jones** who, in response, expressed appreciation of the warm welcome accorded to him. Mr. Jones also conveyed the greetings of the President and members of the Institution of Gas Engineers. The members were afterwards entertained to tea by the Western District.

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SPRAYED METAL COATINGS STANDARD

A new British Standard for Sprayed Metal Coatings has been issued by the British Standards Institution. The new standard (B.S.2569, 1955) is in two parts, (1) protection of iron and steel against atmospheric corrosion, and (2) protection of iron and steel by aluminium against corrosion at temperatures between 120 and 950°C. Part 1 covers the application of sprayed coatings of aluminium and zinc applied by various methods of spraying. It specifies the method of surface preparation and application of the coating, and gives specifications for the metals to be used in coating as well as requirements for the thickness and the adhesion of the coating. Appendices give the methods of test. Part 2 is restricted to sprayed aluminium and provides three different methods for the three different processes whereby specific conditions of the finished coating are achieved. In all other respects, it contains the same type of information as given in Part 1. Copies may be obtained from the B.S.I., Sales Branch, 2, Park Street, W.1. Price 2s. each.

CAREERS IN THE ELECTRICAL INDUSTRY

More than 2,500 schools and technical colleges throughout the country have received a copy of a new booklet listing many scholarships and grants available in the electrical engineering industry. The booklet has been published by the British Electrical and Allied Manufacturers' Association 'to illustrate the interest which the industry takes in education and research and the encouragement which is given to the student who wishes to widen his experience and knowledge.' Mr. D. D. Walker, Chairman of the Council of the B.E.A.M.A., in a foreword to the booklet, says: 'The electrical and allied engineering industry is one of the most progressive in the country, and its importance in the national economy continues to increase. It is fully aware that a regular intake of well-trained and able recruits to fill the many responsible positions in the industry is necessary if expansion is to be maintained.' The booklet gives details of scholarships open to non-graduates, chiefly those leading to a first degree in electrical engineering; post-graduate scholarships and research awards open to senior students; and scholarships and awards permitting study abroad.

Early Experience with a New I.V.C. Installation

By H. WAITON, ASSOC.M.INST.GAS E.

Following is a report of the discussion which followed the presentation of a paper on 'Early Experience with a New I.V.C. Installation' by Mr. H. Waiton at a meeting of the North of England Section of the Institution of Gas Engineers on February 24. An abstract of the paper was published in the 'JOURNAL' of March 16 (pp. 715-719).

Mr. W. R. Garrett (Chairman of the Section) said that in connection with the handling of finely crushed coals, Mr. Waiton should have mentioned that vibrators were fitted to the coal cars to give better discharge. On the question of the cross section of the coke car, he assured Mr. Waiton that this was carefully investigated in the design stage, and it was only due to the abnormal difficulties of electrifying the coke car that it was decided to adopt the triangular cross section. At the time, it was felt that every coke oven works had this shape of car, and that if it worked for a coke oven it should surely work in a gasworks. He was still not certain why the coke oven people did not experience trouble with over-quenching some of the coke. With regard to the control of the carbonising plant, Mr. Waiton had stated that 'the early experiences were not exactly looked upon with appreciation.' It was difficult to understand what he had in mind, as most of the troubles were not due to construction. This was no reflection on the operating staff at Howdon, but it must be remembered that they were not used to the type of plant; there was at times excess of gas over requirements; they were gaining experience with various coals; the operating schedule was varied at short notice; and some of the coals caused 'hanging up' in the retorts, etc.

A lot of the early troubles were caused by too small a breeze pad. One early experience was overcracking in the retorts, which resulted in lamp black formation, and he was afraid that this was entirely due to their own operating staff putting in very light charges. The idea of the hot CO valves was to shut off the bulk of the producer gas in order to reduce the volume to a minimum, prior to insertion of slip plates. The use of butterfly valves would have occupied more space and would certainly not have been as tight as hot gas valves.

Mr. W. K. Tate, President of the Institution of Gas Engineers, said the Northern Gas Board and the Howdon staff were to be congratulated on taking every opportunity of carrying out tests on different combinations of operating factors and so carefully recording the results, since not only would these be of value as comparative evidence with performances in the years ahead, but they would also provide some possible bases for the assessment of the time when the plant must be re-set in consequence of falling yields rather than structural failures in the chamber monolith. Intermittent vertical chambers had always been a favourite of his, and quite frankly he thought they were the best carbonizing plant for erection today, when North East coast coals were the normal fuel. He therefore seized on one or two points in the paper and took out some comparative figures from Portsmouth experience.

Coal Shrinkage and Steaming

Carbonizing washed Boldon coal of some 7% to 8% moisture content three tests had recently been made, with results quite at variance with those shown, and he was unable to account for the difference. They commenced steaming in the ninth hour of a cycle irrespective of the length of cycle, but always maintaining the same overall quantity of steam, 7% of the weight of coal carbonized. It followed, therefore, that the hourly input of steam varied, but from the curves the rate of coal shrinkage, which was more probably coke compaction, always accelerated from the ninth hour. He could not stress too strongly his agreement with the author that a chamber was not the proper place to make water gas—this should be done efficiently in a plant designed for the purpose —but they, too, had found that some steaming was essential to maintain a positive pressure in the chambers, while rather higher temperatures could be worked in the flues without the danger of unfortunate rises at the close of the carbonizing period. Furthermore, there was the benefit of added control over the volatile content of the resulting coke, and probably some assistance to the free discharge of that coke.

Coke Quenching

He sought further details on quenching procedure since, in a new plant under construction, he had abandoned the coke wharf and transporter as an unnecessary complication and expense. They had found that, with their type of car, a water usage of about 250 gal. per ton of coke gave reasonable moisture in the coke and rendered 'hot spots' unlikely, although they endeavoured to spray for 110 seconds, drain under the quench tower for three minutes and drain in the open for 15 minutes.

The average life of chambers at Portsmouth in the past had been about seven working years, both with and without letting down for cold repair in the complete cycle, but he was convinced from many observations that, with two notable exceptions, the failures in refractory brickwork that governed the date of re-setting resulted from movement of the supporting steelwork, and he felt that the designers could well give more thought to that feature. They used water-cooled tie rods. Why could they not have supporting steelwork also cooled or otherwise made able to withstand heat and load without deformation? Obviously the treatment of the silica throughout its life was important, and in scurfing procedure they were in line with Howdon, but they had abandoned the airborne sealer in favour of routine patching, brushing, and spraying with cements of various consistencies, and retort welding. This treatment had been most efficacious and, at the moment, one chamber bench was operating on controlled conditions with every hope of achieving eight years of continuous life, without any periods of shut-down for brickwork repairs.

Producers

He had great confidence in and affection for the built-in step grate producer which was robust, cheap, and—if of adequate size—not too arduous in operation. Granted the quality of gas fluctuated, but that was about the only drawback. Labour difficulty was real in some districts, but in a new installation action could surely be taken to provide satisfactory working conditions in all ways, and they experienced no troubles in Portsmouth or Southampton on that score. He was perturbed to see that they consumed on the Howdon units what they in the south would call boiler nut coke, since that fuel was in the shortest supply of all and they were at their wits' end to find further quantities. The step grates preferred large coke for which their sale was declining—and must continue to decline—although even these operated quite well on broken coke with up to 20% of nuts mixed in. What concerned him almost as much was the quantity of dust extracted from the flues and recuperators. He always thought producer gas made externally was an ideal material, clean and constant, and yet Mr. Waiton expected to obtain about 12 tons of flue dust per annum from producer gas mains and settings, even after the grit arresting equipment had done its work. On two benches of I.V.C. at Hilsea, Portsmouth, with an output of 7.5 mill. cu.ft. per day, heated by built-in step grate producers, some 12 tons only of flue dust had been recovered in three years, and they received an average price of approaching £200 for each of those tons —and perversely they wished they had more.

Mr. H. Waiton, in reply to Mr. Tate, said that the difference in the rate of shrinkage at Howdon compared with the President's experience was due mainly to higher carbonizing tem-

peratures. Because of this, more rapid evloution of moisture and gas would take place in the very early stages, giving rise to a slight degree of fluidity. In addition there would be some physical expansion of the coal mass before distillation commenced. Steaming, in the case of Howdon, did not take place until after shrinkage was in an advanced stage and the charge had assumed a rigid state. Hence the effect of steaming, which was in any case small, would tend to affect the density rather than the size of the charge. Regarding quenching times and quantities of water used, he stated that approximately one ton of water was used to quench one ton of coke and the quenching time was 2¼ minutes.

Referring to Mr. Tate's mention of small coke for the producers, he stated that conditions were apparently different from that area of the country, where it was the large coke which was in demand rather than 'nuts' and 'beans'. The producers had, however, proved capable of working on many combinations of sizes according to the conditions prevailing at the time. Regarding dust in the mains and settings, the Howdon plant lent itself to pretty thorough removal. One was tempted to ask how much Mr. Tate left behind.

Mr. A. E. Morris (West's Gas, C.O.L. Division), after congratulating Mr. Waiton on his paper, stated he felt it was a very factual paper of experience and was accordingly of great value. He considered that, although coal mixing was not 100% efficient, it had nevertheless permitted the use of an appreciable proportion of highly swelling—or better, poorly-shrinking—coals. It would also permit the use of a proportion of non-coking coals. Referring to the thickness of the chamber walls being 4 in. instead of a construction of recessed bricks, this would, in his opinion, ensure a much longer life. With reference to external producers, he emphasized the lower temperature of the producer gas, which could result in increased fuel consumption. He also stated that the dark patch in the ovens referred to in the paper was due to lower producer gas temperature, which affected not only flame temperature but also speed of combustion.

On the subject of dust in producer gas, he agreed that this could affect plant performance when deposited in flues, but it was not usually considered to be the cause of putting a plant out of commission. He considered slight steaming a necessity in order to maintain as far as possible pressure in the chamber, which dropped after the plastic layers had met. This drop in gas evolution and reduction in pressure was shown clearly in Fig. 6 of Mr. Waiton's paper. In his opinion, a great deal of damage was done to carbonizing plant due to reduction of pressures and indrawing of waste gases after the peak evolution of coal gas was completed.

Mr. G. E. Anderson (Newcastle-upon-Tyne) spoke of the value of Mr. Waiton's paper as a contribution to the Institution based on practical experience. He pointed out the difficulties on a base load plant by operating on a relatively small holder capacity. With reference to what he termed the super-plus outputs which had been obtained from the plant, he felt that not only was credit due to the plant but to the staff who operated it.

'Over Indulgence'

Dr. G. Milner (Power-Gas Corporation, Ltd.) said although the nature of his work did not permit him to be directly interested in carbonization of coal, he read through Mr. Waiton's paper with great interest and would like to congratulate him on the production of a paper so easy to read and which maintained the reader's interest. As a representative of the Power-Gas Corporation, he was more interested in Mr. Waiton's section relating to the gas producers used for firing the installation and especially in the behaviour of the hot gas in respect of its cleanliness. It was gratifying for his Company to be told that their principal faults were all due to over-indulgence. This over-indulgence was intended to benefit and please the client, but from Mr. Waiton's remarks it seemed that some of their best intentions had not produced the results which they hoped for. On the other hand their efforts to supply a reliable plant yielding a hot and reasonably clean gas appeared to have come well up to expectations in all aspects of performance.

The loss of 100°C. in the temperature of the gas between the producers and the ovens was to be regretted, but was largely caused by the layout of the plant. Care was taken to see that an economic amount of internal insulation was provided in order to keep such losses to a minimum. The loss of temperature was easily seen as a source of increased fuel consumption, and it was equivalent to somewhat less than 4 B.Th.U. of the C.V. of the cold gas. There were, however, other factors which could have a bigger influence on performance and which were sometimes overlooked. Thus hard oven coke of ⅜ in. to ¼ in. grading would yield a gas having a C.V. 10 B.Th.U. per cu.ft. higher than that obtained from the same coke graded 1½ in. to 2½ in., and 20 B.Th.U. per cu.ft. higher than that obtained from the same coke graded 2½ in. to 3¼ in. This showed the importance of using the smaller size of coke for producer gas work, and during the start up of the installation when the coke screening plant had not yet been installed some difficulties were experienced due to the necessity of feeding over-sized coke to the plant. In addition slightly under-carbonized horizontal retort coke could yield gas appreciably richer than that obtainable from well-burned oven coke, so that the presence of some volatile matter in the smaller sizes of coke could do much to offset losses of sensible heat due to the fall in temperature between the producer and the vertical retorts.

Another item which could be easily overlooked was the presence of steam in the producer gas resulting either from the moisture in the coke or from undecomposed steam. In this instance the gas analyses indicated that 90 to 95% of the steam supplied in the blast was decomposed. This left but small room for improvement in this connection, but it was generally considered that blast saturation temperatures of below 50°C. were to be preferred in order to get good furnace gas rich in carbon monoxide and lean in respect of hydrogen. The tendency of a fuel to clinker, however, especially with a mechanically-operated plant, limited the extent to which the blast saturation might be reduced and Mr. Waiton's reference to difficulties with small fuel was of interest. Clinkering tendencies were related also to the rating of a plant. The units at Howdon were fairly easily rated and they fitted a concentric type of grate. Normally at higher ratings they installed a grate slightly eccentric and this permitted working nearer to the danger line of clinker formation, and in the light of Mr. Waiton's experiments no doubt would be beneficial in this instance.

The moisture content of the fuel was fairly high and was sufficient to reduce the cold gas C.V. by 3 to 4 B.Th.U. per cu.ft. This steam would have an adverse influence on flame temperature and would also carry away sensible heat from the settings thus necessitating the burning of more coke in the producers. The desirability of using dry coke was obvious. Although tests had shown the possibility of operating at much higher ratings than those for which the producers were installed, the type of producer at Howdon, fitted with a vaporizer jacket operating at atmospheric pressure, was not really suitable to the higher rates of gasification. The same size of producer fitted with a pressurised boiler jacket could be used for gasification rates well in excess of the maximum figures obtained at Howdon and some units had been tested up to 90 tons of coke per day.

Figures quoted by Mr. Waiton for dust removal were of interest and agreed well with observations made during 1952 and 1953 at Leicester gasworks in connection with a battery of five producers fitted with a cyclone type of grit arrester. At that works, gasifying 40 tons of coke per day with four producers working, they recovered approximately 300 lb. of (dry weight) from the lutes of the cyclones each day. This was equivalent to approximately 50 tons of grit per annum and on a *pro-rata* basis was somewhat higher than Mr. Waiton's estimate of 78 tons of grit recovered per year when gasifying about 100 tons of coke per day. At Leicester the method of feeding coke was different, there being no de-breezing screens such as were installed with the Howdon plant. At Leicester they estimated that the amount of dust which settled in the bus main was of the order of one ton per annum while the amount of dust removed from the CO necks was about two-thirds of that amount. In that way they estimated that the grit arresters were removing about 97% of the settleable dust. Particle size analyses showed that whereas the dust removed from the lutes of the cyclone contained 80% bigger than 50 microns the material settling in the CO necks contained 80% smaller than 50 microns. This apparently good performance did not mean that the gas had a particularly low dust content, for measurments at Leicester showed that there were 8 to 10 grains of dust per 100 cu.ft. of gas measured under standard conditions. This dust remained in the gas leaving the grit arresters so that the overall efficiency

of dust removed was about 80%. The total dust in the gas leaving the producers was about 0.4% of the weight of coke.

Similar tests at Howdon had shown that approximately nine grains of dust per 100 cu.ft. remained in the gas passing through the bus main. Some 95% of that dust was less than 30 microns in size. As shown by Mr. Waiton it apparently either burnt or passed through the settings without any trouble. It thus appeared that the overall efficiency of grit arresters at Howdon was again of the order of 80%, and the total loss of fliers from the producer was about 0.35% of the coke charged. The agreement between test results at Howdon and at Leicester was good, but the point of real significance was the freedom from trouble and ease of control of the settings as brought out by Mr. Waiton.

External hot gas producers, because of the inevitable heat losses along gas mains, must be less efficient thermally than built in producers, but as Mr. Waiton indicated there were many compensating factors such as labour problems, general ease of maintenance, ability to use cokes unsuitable for step grate producers and probably prolonged working lives of settings.

Mr. H. Waiton said the observations of Dr. Milner about higher C.V. from smaller coke were confirmed when they worked a producer for some time on 100% 'beans.' The C.V. of the gas from that unit was of the order 10 B.Th.U. higher than that from the others. This was almost certainly due to the volatile matter in the small coke. Desirable as it might be to increase the C.V. of producer gas, it was even more desirable to drive off all volatile matter in carbonization.

Mr. W. R. Garrett said Mr. Waiton might not know that in the design stage long CO mains which he criticized were carefully investigated, and it was finally decided that it was impossible to justify other than the 4½ in. firebrick and 4½ in. insulation brick to reduce the loss of heat in the producer gas. On completion of the job, certain tests were carried out which tended to confirm the original findings. Some £600 was spent on reducing the heat loss from the CO valves and connections into the setting, as in this case there was sufficient saving to justify the extra capital expenditure. They still had the feeling that it would pay to put waterproofed insulating blankets over the exposed CO mains, and thought that this should be carefully investigated.

A Challenge

Mr. W. Cummings read a contribution from **Mr. North** (Sunderland), who was unable to be present, in which he challenged the author's statement that 'three features have not pleased and all may be said to have been the result of over-indulgence.' A gas valve was the only positive means of isolating a gas stream without danger to the operator. If a hot gas valve was correctly lubricated and regularly moved on its seat no difficulty should be experienced in maintaining it operable. The alternative butterfly valve suggested by Mr. Waiton would be almost impossible to maintain were it sufficiently close fitting to be gas-tight. The slip plate was provided as an additional safeguard to be used after the hot gas valve was closed, and he suggested that to operate and rely on a slip plate only in a 36 in. producer gas main at even 0.5 in W.G. pressure was asking for accidents.

The author apparently criticized the siting of the producer house on the basis of 100°C. loss in temperature along the producer gas main, and yet throughout the paper he was repeatedly drawing attention to the advantages of lack of dust in the bench flues and gasways. Mr. North suggested that this temperature drop was irrevelant and that it was the overall heat transfer which mattered. Had the producers been sited in the chamber house the whole 90 tons of dust would have been passed into the settings instead of the 12 tons under the present arrangement. The consequent reduction in total heat transfer due to this dust would possibly be greater.

There was obviously a happy medium somewhere, and whether or not they exceeded the limit at Howdon, he was not prepared to say without further investigation. Perhaps if Mr. Crowther could be persuaded to build another 'Howdon' at Hendon they would find the answer. In fact the location of the producer plant was decided on after considerable deliberation, and when finally selected was accepted as the most suitable, having regard not only to the length of the producer gas main but the distribution of coal to the main bunkers, the collection of coke from the wharves, and the return of screened coke to the producer and C.W.G. plants. The problems arising from all these factors were adequately described in Mr. Garrett's paper given early 1952 to the Institution of Structural Engineers.

Regarding the merits of roofing or enclosing a producer plant, the author had himself given the answer. He would, no doubt, not have troubled to prevent the gas leakage which he had been forced to do, and with a mere roofing the absenteeism on the plant would not have been the lowest on the works; in fact the latter item would appear to be a justification for enclosing all producer plants in a similar manner.

Mr. H. Waiton, in reply to Mr. North, said the difficulty of lubricating hot gas valves was widely enough appreciated and needed no comment. The valves in question were moved and lubricated every week and had been so treated for three years. The slip plates provided were quite sound, and since they projected well past the outer circumference of the gas main, with a joint on both faces, they could not possibly allow gas to leak back to the producer. C.W.G. plant valves were not of similar design and gave little trouble. Regarding siting of the producers in the chamber houses he agreed that this would have been less desirable though a gas temperature drop of 100°C. could hardly be called irrelevant. Their present position favoured deposition of dust before reaching the settings. Alongside the settings they would also have had infiltration of dust into the mechanism.

Mr. R. W. Crowther (W. J. Jenkins & Co., Ltd.) felt that the modified type of coke quenching proposed should reduce the moisture in the coke, and it was likely that they would find their water consumption reduced below the ton now necessary to quench a ton of coke. He felt that a hydraulic ram for tipping the coke car was certainly the best approach. He considered that electrical operation would not be sufficiently reliable. He also felt that a mechanical extractor to step grate producer might go a long way to meeting the needs of both the step grate and the external producer and simultaneously eliminate faults of both.

Mr. W. R. Jessop (Cleveland) said the coke to producers at Howdon was rather lower than at Cleveland, but in the case of the latter no diluent was used. He asked how the mechanical part of the plant was standing up to base load conditions. The labour used on the smaller plant still remained comparable with that of the Howdon plant.

Mr. Waiton said repairs to coal buses were mainly confined to electrical faults. One or two offtake valves and levers had caused minor trouble. He had heard of wear in top lids on a similar plant, but had not so far had similar experience at Howdon. After the first six months, during which some teething troubles took place, no difficulties had been experienced with bottom doors. He felt that the hydraulic operation system needed careful maintenance and attention. The life of coke cars was rather longer than expected.

Mr. B. Richardson (Redheugh) referred to the time when he had informed students that 92% of the coke from ovens was over ¾ in. size and that they would carbonize all the types of coal that horizontal retorts were able to handle. This had not been proved in the case of Howdon. He emphasized the value of coal blending as distinct from mixing. An excellent coke could be formed from a blend of Northumberland and Durham coals which were sized below ¾ in., but lower carbonizing temperatures must be used, together with consequent longer carbonizing time even when blending was used. A higher carbonizing temperature and a higher throughput would result in an inferior coke. Referring to coke shrinkage, he felt that high temperatures caused degradation of the gas in passing through the coke charge and that carbon was deposited among the coke. This resulted in coke yields being always in excess of theoretical anticipations.

Mr. W. Sutcliffe (Blyth) was critical of the relatively high moisture content of the coke and of the breeze. In his own experience, he felt that there was a remarkable ability in manpower to change successfully from one type of plant to another. He asked what would be the maximum output of the plant if the gas were reduced to 475 B.Th.U. by steaming rather than by the use of diluent.

Mr. Waiton said the altered coke cars would no doubt eliminate a good deal of the undue moisture content in the coke. Referring to a maximum throughput produced by steaming to 475 B.Th.U., he stated that it was unlikely that such a test would ever be made because major modifications would be necessary to the plant.

SOHO*

SOME PROBLEMS OF THE INDUSTRIAL GAS ENGINEER IN LONDON'S ENTERTAINMENT CENTRE. — By J. C. SALMON, WATSON HOUSE

'SOHO' does not conjure up the impression of a district teeming with industrial activity, but in common with all Central London districts a substantial amount of industry is carried on there. And, as would be expected, there is a fairly large call for cooking equipment of a special design which has to be made to suit conditions peculiar to the catering trade.

The most common of these is the special hotplate for numerous Chinese restaurants situated in the district. The essential difference between a Chinese restaurant and a European one, is that in the latter the food is generally prepared, cooked and maintained ready in anticipation of the customers' orders, while in a Chinese restaurant, the customer's food, although prepared, is not cooked until he has placed his order, the various ingredients being heated in shallow curved bowls from which the food is served immediately after cooking. A typical appliance of this kind consists of a framework of 2 in. × 2 in. × ¼ in. mild steel angle, with a solid top of ½ in. mild steel plate, in which circular holes are cut revealing the burners. The main burners, along the front of the appliance, are Fletcher Russell No. 46, concentric ring burners, the mixing tubes having been shortened in order that the centres of the burners are at a convenient distance from the front of the hotplate. It is on these burners that the special Chinese cooking is carried out, while the rear burners with small cast iron drip-proof heads serve for the cooking of such things as rice or soup. It is the usual practice to provide a pot rack beneath the hotplate and not uncommon to fit a further rack at a higher level to carry the ingredients of dishes being prepared.

One great difficulty to be overcome in the construction of an appliance of this sort is accurately to determine the consumer's requirements. The size of the appliance will be limited by the space available, while the number of main burners will be determined by the number of cooks employed. The tortuous passages and staircases leading to the kitchen have to be taken into account for purposes of delivering the completed appliance, so it will be seen that the final layout and construction of the hotplate is the essence of compromise.

Numerous other appliances have been made up for catering establishments, including one for the preparation of 'Hamburgers' the meat constituent of which is fried on the solid hot-plate, while the oven serves to warm the rolls in a moist atmosphere.

The manufacture of such cooking appliances as described in the foregoing is not undertaken until we have made certain that no standard appliance which would fulfil the consumer's requirements is readily available. These catering appliances are made up and tested individually before despatch, as are all industrial appliances, but it is always made clear that they are 'specials' in every sense of the word and may not conform to all the requirements of B.S. 2512:1954, 'Gas Heated Catering Equipment.'

Foreign Confectionery

Allied to the catering trade and often carried on in conjunction with it, are a number of establishments producing foreign confectionery. An example is the Kataifi, generally made by Cypriot and Greek concerns and the exact composition of which I have never been able to ascertain. A paste consisting of flour and water and other ingredients is made up, and held in a tank at the end of an arm poised above a heated copper turntable about 5 ft. in diameter. The table is rotated by hand and when running at a suitable speed the paste is allowed to run out of the tank through a number of jets fitted in its base. At the same time the tank is moved from the centre to the edge of the turntable. The paste solidifies on touching the turntable and assumes a strawlike appearance and texture. When the table is completely covered, the supply of paste is shut off, the table stopped, and swept clean and the process repeated. The straw-like material subsequently surrounds a filling and is formed into rolls and baked in a conventional oven.

The problem presented to the industrial gas engineer in this instance was to heat the copper turntable evenly and to ensure that the flames would run. This is generally done by employing post-aerated jets of the Bray cross-lighting or star patterns. This would be a simple enough matter if the appliances were soundly constructed initially, but as a rule the turntable is mounted on a flimsy mild steel angle stand, the top itself being a light gauge copper disc secured to a ring of mild steel bar. The turntable is never flat, so that the arrangement of burners beneath it has to be constructed to allow for this and the play in the spindle is often quite considerable.

We have never yet been given an opportunity of designing and constructing a complete appliance of this type; in all cases the consumer has had the stand and turntable made up, then, after having accepted it simply calls in the gas board to apply the burner equipment to it.

A Miscellany of Trades

The garment and millinery trades are well established in the Soho area and for the most part use standard ironing stoves and steam boiler equipment. There is, however, a small demand for such appliances as hat steamers in establishments where the installation of a steam boiler would be an uneconomic proposition.

In Poland Street there is a fairly large establishment engaged in the melting of gold and silver. We were called in not so long ago to reduce the noise made by the existing high-pressure gas crucible furnaces. The consumers in question had been served with an injunction to cease activities unless the noise could be cut down. Crucible furnaces are nearly always guilty of this nuisance, and the high-pressure gas-fired equipment used here was no exception, but it was found that the fitting of air-blast tunnel burners to the furnaces cut down the noise considerably and enabled the consumers to carry on their work.

A Low Standard

In Soho a good deal of process engraving and printing block manufacture is carried on. In such a trade the bulk of the equipment, comprising costly apparatus and machines is provided by specialists in this particular field. The melting of the stereo-metal and the drying of plates and negatives is incidental to the main processes, so that one generally finds that the gas using equipment in such establishments to be of a rather low standard from a gas engineer's point of view. We have attempted to evangelize the industry, but cannot claim that we have been very successful in this respect. We are generally confronted with a poorly constructed appliance which has already been purchased by the consumer and are given instructions to apply burner equipment to it. When given an opportunity we have supplied new and well designed equipment to one or two firms and it has been found that in the trade there is a sort of jungle telegraph and the news of a new appliance being installed in one works soon spreads to others.

The drying of negatives and plates is quite often carried out in cupboards fitted with small electric heating elements, or in metal cabinets made by the plant manufacturers to which we are called upon to fit burner equipment. We are rarely asked to provide complete drying cabinets, but have recently had an opportunity for supplying new equipment to a firm in the Central London area.

* From 'The Cubic Mile,' a paper presented to the London and Southern Junior Gas Association on March 4, 1955.

LADY MEGAN IN A WELSH KITCHEN

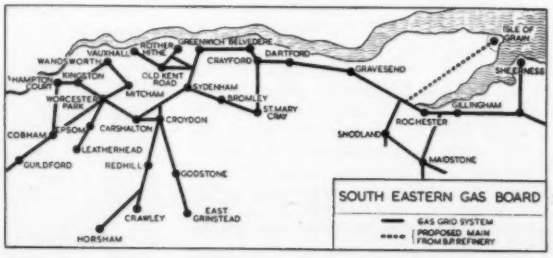
It is not often that a famous and titled personality can be seen eating Welsh cakes in the window of a gas showroom, so that the presence on St. David's Day of a crowd of spectators in front of the Murray Street premises of the Llanelly undertaking of the Wales Gas Board was easily explained. The occasion was a visit by Lady Megan Lloyd George to inspect the display of an old-world Welsh kitchen, brought up to date with modern gas appliances. Some of the furniture included a fireside chair and dresser nearly 150 years old. The display, assembled for St. David's Day, was staffed by the Board's home service advisers and showroom attendants, dressed in traditional Welsh costume. Lady Megan, who was received by Mr. Darrell W. Rees, Engineer and Manager of the undertaking, was accompanied by Mr. and Mrs. Dan Williams, and presented with a bouquet by Miss Joan Glover, a member of the Board's staff, who in conjunction with the Llanelly Aelwyd, had co-operated with the management in the preparation of the display. Expressing her appreciation of the display, Lady Megan said she was delighted to see that a nationalised industry had associated itself with so much enthusiasm in the celebration of the national day of Wales.

Oil Gas Plans for South East

The South Eastern Gas Board and the British Petroleum Co., Ltd., have agreed jointly to examine the practicability of building a plant to convert petroleum products available at the Company's Kent oil refinery to town gas of acceptable quality. The Segas process, developed by the South Eastern Gas Board, provides a degree of flexibility which can be exercised to considerable advantage where the gasification plant is sited in or adjacent to a large-scale oil refinery which can thus ensure the requisite regular day-to-day supply of feedstock.

The proposal is, therefore, that the installation should be situated at, and operated in conjunction with, the Kent oil refinery. The gas board would thus join with the British Petroleum Co., Ltd., to place at the disposal of the joint operation their combined technical experience in gas manufacture and the cracking of petroleum feedstock in a way which will facilitate the discharge by the gas board of their statutory obligations. It is expected that the initial installation would convert some 50,000 tons of petroleum products a year to gas. It would have a daily output of 15 mill. cu.ft. of gas and be arranged for extension to a capacity of 40 to 50 mill. cu.ft. daily with an annual petroleum usage of up to 150,000 tons.

The gas, which would be made at the British Petroleum Company's oil refinery on the Isle of Grain, would be fed into the board's gas grid system near Strood. This grid system, which is being rapidly developed, will serve the whole of South London and extend to Guildford, Horsham, Maidstone and Rochester as shown in the accompanying illustration. The grid will cover about 1,750 square miles and serve four million people.



This diagram shows the South Eastern Board's grid system and the proposed main from the British Petroleum Company's refinery.

N.A.L.G.O. Pay Demands: Revision Deplored

A conference of the National and Local Government Officers' Association in London on March 12 adopted a motion deploring that the revised salary structure of the National Joint Council agreed on August 31 last year did not 'accord with the intention or spirit of the motion adopted by the special conference of the Association on April 3, 1954'. Members of the gas industry branches of the Association supported the motion, which pressed for the abolition of the lower general division grade previously agreed and a revision of all salary scales, so as to restore their 1946 purchasing power, while protecting improvements such as assimilation of grades, or the contraction of the general division which was gained by the need to encourage recruitment of juniors.

More than 1,200 members of the Association attended the conference, which was called on the requisition of 108 of the Association's 1,360 branches to consider the Wandsworth motion protesting about the recent revision of local Government salaries and calling for further increases.

Scot's Safety Device

A Greenock man, Mr. John Wandrum, of Sutherland Road, who ran his car on moth-balls during petrol rationing, has invented a gas cut-off safety valve, and Scottish Gas Board officials have asked to see the prototype. The device is primarily for use in houses with shilling-in-the-slot meters where accidents have occurred because bedroom fires which went out were overlooked when more money was put in the meter. It is stated that his invention can be attached to a gas fire or cooker for a few shillings. When money is put in the meter and gas passes through the unlit fire or fixture there is a click and the gas is automatically cut off.

Edinburgh Home Safety Council, concerned to reduce accidents in the home, has undertaken to review proposals made by the city Medical Officer of Health regarding gas risks where older people are concerned. It is proposed that some system should be devised to inspect gas taps and gas fittings in homes occupied by elderly people. This follows a similar proposal from Halifax advanced at a recent conference on home safety. It is typical of several moves made to meet the situation.

Ships that run on rails

It is imaginative, perhaps, to suggest that our fine British ships run on land-bound rails. Yet there is some truth in the thought. Is it not true that ships are made of steel, which in turn is manufactured from iron-ore and coal and limestone? These raw materials are taken *by rail* to the mills, and the steel plates into which they are made are sent *by rail* to the shipyards. And railways carry ships' cargoes, too!

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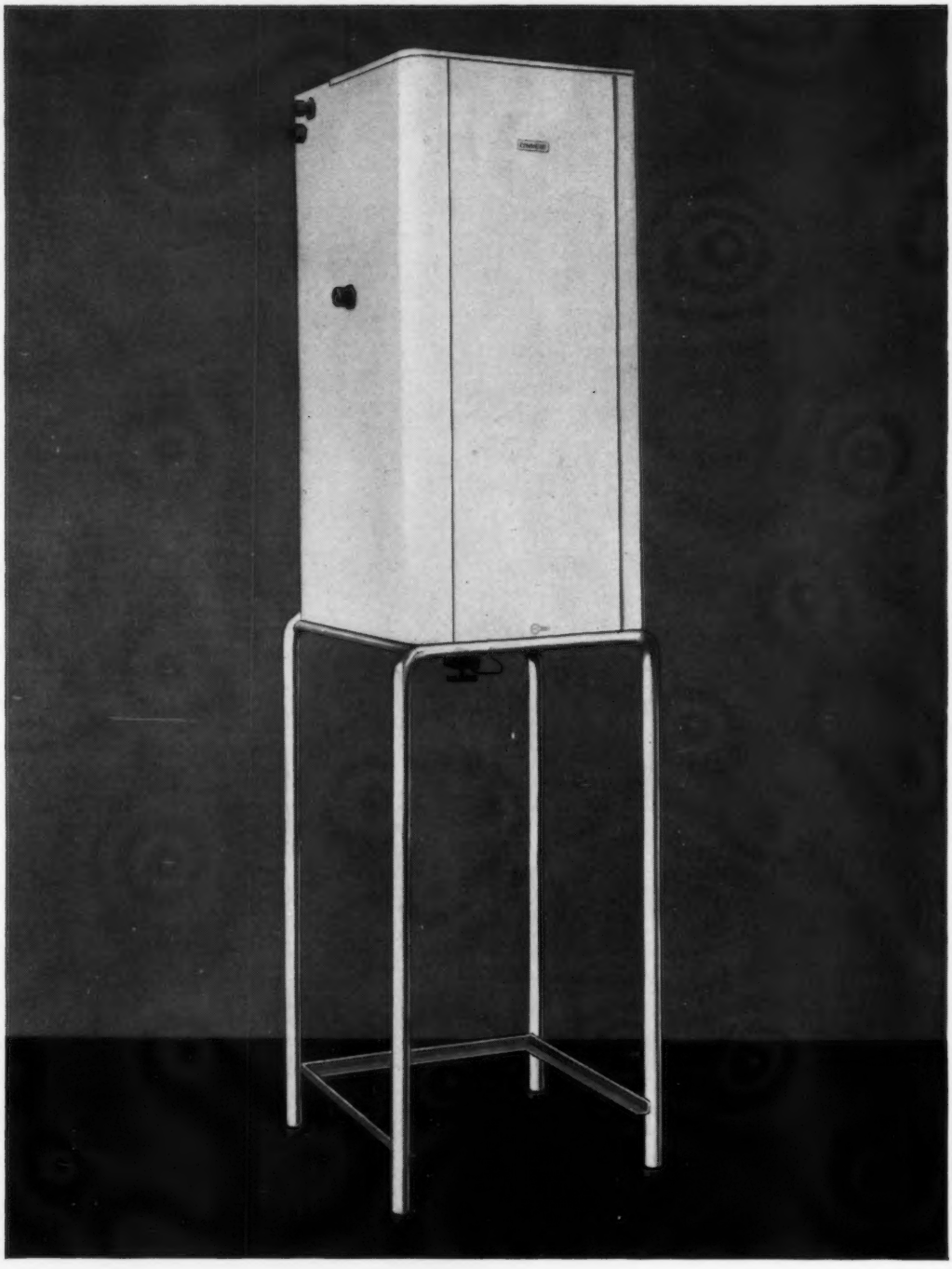

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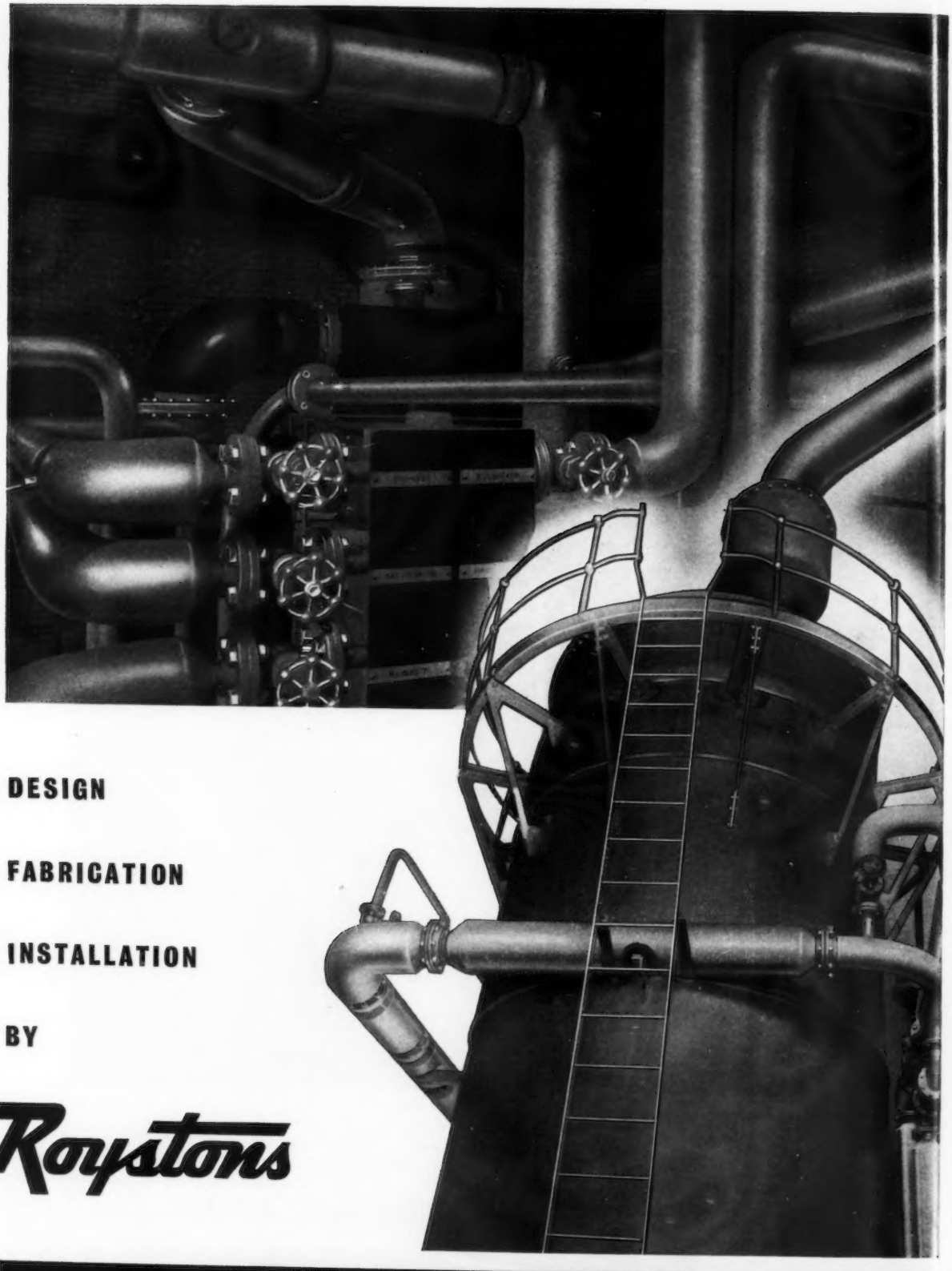

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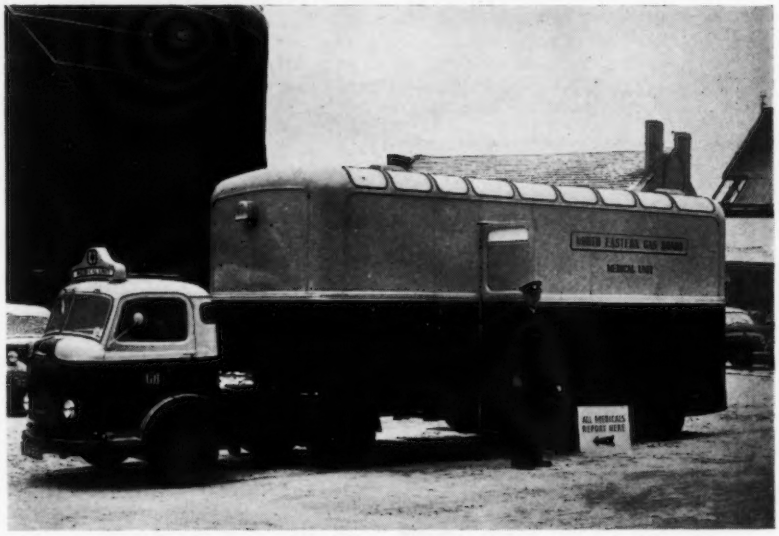
North Eastern Gas Board's Surgical Unit

Provision of medical services in industry has now become an established part of the industrial pattern of this country both in private enterprise and in the nationalised concerns. Nine of the area gas boards either had a full-time medical service already in existence on vesting day, or have established such a department since, and in 1954 the North Eastern Gas Board decided to provide a service for its employees. Accordingly, a Chief Medical Officer was appointed to establish and co-ordinate a medical department for use throughout the Area.

In view of the scattered nature of the manufacturing and distributing stations controlled by the Board, the provision of medical cover presented special problems for, apart from establishing first aid rooms and works surgeries for treatment of conditions arising at work, if a medical service was to be carried out properly, it was essential for a doctor to have facilities for consultation with, and examination of, patients under proper conditions. Many of the first aid rooms, although adequate for their specific purpose, did not and do not provide the accommodation and facilities necessary for this extra function.

Accordingly a mobile surgery was constructed for use by the medical staff in parts of the North Eastern area outside the main centre of Leeds, and by so doing the necessity of building separate consulting rooms at each undertaking has been avoided, and the doctor is able to visit the smallest undertaking and see patients under good conditions.



Exterior view of the mobile surgical unit

Interior of the mobile surgery showing couch for examination of patients

The unit is constructed on a low loading articulated trailer 21 ft. long, and is drawn by a Karrier Bantam tractor. It has a main consulting room 17 ft. by 7 ft. 6 in. divided into two compartments by a shallow stair. In the forward compartment are situated an examination couch, instrument cupboards, and store lockers. In the rear compartment is the Medical Officer's desk, chairs for patients, a sink unit with water heater, and further cupboards. Leading off this are two sound-proofed doors which open on to two dressing cubicles each of which is approximately 4 ft. by 3 ft. 6 in. in size. There is a rear door from each changing cubicle leading to the outside, and these are used as the patients' entrance. Each cubicle has a built-in electric tubular heater, a folding seat, a mirror, and hooks for hanging clothes.

Lighting in both the cubicles and in the main department is by fluorescent strip lighting, and natural daylight is provided through opaque perspex roof lights. The heating in the main consulting and examination room is by electric convector heaters, but provision is made to connect a Calor gas fire for emergency use. Water heating is by Calor gas and an Ascot water heater, and there is a gas point for a bunsen burner and a sterilizer. Twin Calor gas cylinders are carried in a cupboard below the sink unit.

Water for the heater is carried below the floor in a 25 gal. tank, which has an outside filler, and it is fed to the Ascot heater under pressure by an electric pump which is foot operated. There is a separate drain tank provided. The floor is covered in blue mottled rubber floor covering. All working surfaces of cupboard tops, etc., are covered in formica, and the body of the vehicle is heat-insulated by fibre glass packing between aluminium skins.

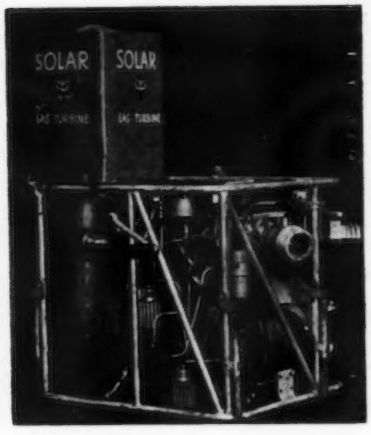
The whole unit is extremely manœuvreable, and is in constant use in all the groups outside the Leeds area.

National Savings in Industry.—Figures issued by the National Savings Committee show that at the end of September last 1,171,634 workers in places of employment in England and Wales with over 500 people, apart from the nationalised industries, were saving regularly through 2,142 savings groups. Their total group savings for the six months ended September 30, 1954, were £15,413,734. For the same period total group savings for the nationalised industries, the Civil Service, and local government were £10,668,766. Groups totalled 14,045 with a membership of 855,125.

An Anglo-American Venture

As briefly reported in the 'JOURNAL' last week a new British company with an initial capital of £150,000 has been formed to manufacture in England the American Solar Aircraft Company's Mars 40/60 h.p. gas turbine engine. The new company is Sugg Solar Ltd., formed as a subsidiary of William Sugg & Co., Ltd. The Solar Aircraft Company of San Diego, U.S.A., is a shareholder in this subsidiary. William Sugg & Co., Ltd., have extensive production facilities for precision engineering and, as a contractor to the Government, is A.I.D. and A.R.B. approved.

The agreement was concluded after a visit to San Diego by Mr. W. T. Mattock (Chairman and Managing Director of Sugg), Mr. R. W. Young (Sugg's Financial Director), and Mr. Patrick Johnson (Manager of Solar's European Division, who initiated the association). The Board of the new Company will include:—Mr. R. W. Young, Chairman; Mr. W. T. Mattock, Managing Director; and Mr. C. C. Penfold, Sales Director (Directors of Wm. Sugg & Co.); Mr. Patrick Johnson and Mr. Christopher Dykes (Solar Aircraft Co.'s Representatives). Sugg Solar Ltd., will manufacture the gas turbines for both military and industrial uses at Crawley, Sussex. The new Company will have licence rights in the United Kingdom, Europe, and the Commonwealth countries with the exception of Canada, and the licence covers all present applications of the Mars engine, other applications now being developed, and any future developments.



The Solar Mars 40-60 h.p. gas turbine unit.

Announcing the new company, Mr. Edmund T. Price, President of Solar, said in San Diego, 'While several British gas turbine and turbo jet designs of such firms as Rolls Royce, Bristol, and Armstrong Siddeley have been licensed to United States companies, this is the first American gas turbine unit to be licensed in Britain. We are particularly pleased that this Solar development, which has taken place in less than a decade, has been recognized by a highly respected British engineering and manufacturing company.' Referring to Sugg's pioneer work—the firm was founded more than 118 years ago—Mr. Mattock said, 'Now that we have decided to expand our business further, we are pleased that we can enter another pioneer industry—that of the gas turbine, which I feel has a great future. We believe that the Mars gas turbine design has a big market potential in Europe for a wide variety of uses, and we are certain that the coming interchange of technical information between Solar and ourselves will hasten its progress.'

The Mars gas turbine is a small portable plant developing up to 60 h.p. It operates at a speed of approximately 40,000 r.p.m. on natural gas, diesel oil, jet engine fuel, or high octane petrol. The basic engine, including speed-reducing gears, weighs less than 100 lb. and is smaller than a 2 ft. cube. It has hand or electrical starting, and can be used as an airborne auxiliary power unit, a portable fire-fighting pump, an emergency marine pump, a ground power unit for starting jet aircraft engines, as a prime mover for generators, as a source of compressed air, and as a power source for electronic equipment. Mars auxiliary power units installed in American Douglas Globemaster transport aircraft have recorded over 22,000 trouble-free hours' service and are also fitted in the military version of the Lockheed Super Constellation aircraft.

Royal Society of Arts

The Royal Society of Arts, as Trustee for the endowments concerned, offers a number of prizes during 1955. The Howard Trust was established in 1868 for the purpose of making awards periodically to the authors of treatises on steam or other motive agents, and a prize of £50 will be awarded to the author of a treatise on some aspect of the subject of mechanical motive power.

The Benjamin Shaw Trust was founded in 1876 'for the promotion of improvements in all matters relating to unhealthy and dangerous occupations', a subject in which the Royal Society of Arts has taken a practical interest ever since its foundation in 1754. A prize of £20 is offered 'for any discovery, invention, or newly-devised method of obviating, or materially diminishing any risk to life, limb or health, incidental to any industrial occupation, and not previously capable of being so obviated or diminished by any known and practically available means'. Entries may be in the form of descriptive essays or models.

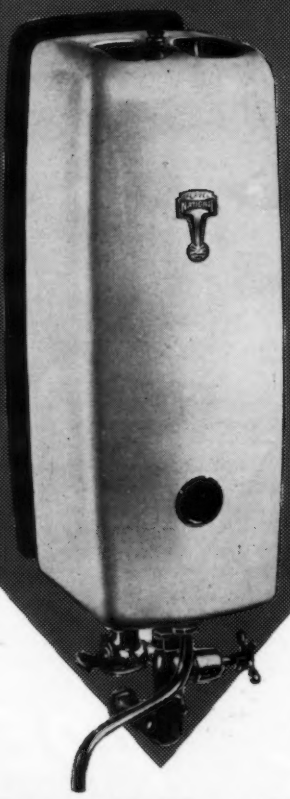
Under the Fothergill Trust (established by the will of Dr. Fothergill in 1821) a prize of £20 is offered for a descriptive essay or model embodying some new idea for the prevention or suppression of fire.

Entries must be received by the Secretary of the Royal Society of Arts, 6/8, John Adam Street, Adelphi, London, W.C.2, not later than July 31.

READING TRADE AND INDUSTRY

The Mayor of Reading, Councillor A. E. Smith, visited the Southern Gas Board stand at a Trade and Industry Exhibition sponsored by the Reading Savings Committee. With the Mayor are (left) Mr. H. Cecil Lewis, Commissioner for National Savings and (right) Mr. Athol Brown, Group Manager of the Northern Group, Central Division, Southern Gas Board. The exhibition, which included various representative trades and industries of Reading, was open for five days and the Southern Gas Board stand did an encouraging amount of business.

The public is impressed by this new Water Heater!



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Hot water for the Nation!

FLAVELS of LEAMINGTON

Makers of fine cooking and heating appliances since 1777

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As the champion hurdler's faultless performance and flawless appearance delight her critical spectators, so the faultless performance and flawless appearance of the Century Cooker delight the critical housewife . . . as the champion's perfect hurdling is the result of years of training and practice so the Century is the result of R. & A. Main's years of experiment and research.

Always to the forefront in improving the efficiency of the gas cooker, R. & A. Main Ltd. have been "first in the field" with many outstanding features . . . in 1922 Main introduced the simplified form of cooker construction . . . in 1927 Main were first with an all-enamelled cooker . . . and in 1935 Main introduced the first all-sheet metal cooker.

The No. 20 Cooker was the first chassis-less model to be produced and marketed in Britain, and it was also the first cooker to incorporate an oven-flue vent discharging in front of the backplate. The high efficiency and popularity of the Century has indeed proved the worth of Main's years of constant research.

MAIN No. 20 CENTURY GAS COOKER

C1

Note the name - made by MAIN

R. & A. MAIN LIMITED
LONDON and FALKIRK

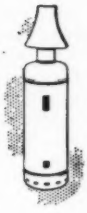
there is a MAIN water heater for every domestic purpose . . .

instantaneous for a complete household service . . . the M.I. Multipoint

instantaneous for the bath . . . the New Junior

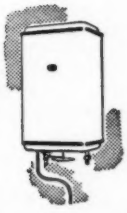
instantaneous or storage

for a complete household service . . . the G.L.C. Circulator



storage for a complete household service . . . the Thermain No. 15

storage for the sink or lavatory basin . . . the Thermain No. 2



MAIN WATER HEATERS Ltd.

Gothic Works, Thornton Rd., Croydon Surrey
W13

Serious Explosion at Retford Gasworks

Work was being done in the valve house at Retford gasworks, Notts., on the evening of Wednesday, March 16, when at a few minutes past 8 o'clock, a serious explosion occurred which demolished the valve house and the adjoining governor house and stores and ignited a nearby gasholder, which was seriously damaged by flying debris. Emergency action was taken at once and officials from Divisional Headquarters at Sheffield were on the scene within a very short time. Seven men were injured in the explosion and the District Engineer, Mr. Frank Beaumont, was found to be missing, feared trapped in the wreckage. Work went on day and night during the following days in an effort to find Mr. Beaumont, and to lay temporary mains to bypass the damaged plant in order to restore, as soon as possible, the gas supply to the town, which had been cut off at the time of the explosion. The town mains were purged with nitrogen on Thursday and the gas supply was restored by 7 p.m. on Sunday. A force of fitters brought in from surrounding districts toured the town on Thursday, turning off at the meter the gas supply to every house or establishment, and on Sunday, from 8 a.m. onwards, the force, further increased to about 150, reassembled to tour the town again, to turn on the supply and to check each consumer's installation and appliances to ensure that everything was in order.

Considerable help was received from local firms, in particular, W. J. Jenkins and Co., Ltd., of Retford, and many offers of assistance were received from industrial firms connected with the industry.

The body of Mr. Beaumont was discovered on Friday night after the tank of the damaged holder had been drained.

Southern Gas Board Fined

Fifty-seven bags of coke were weighed by a Weights and Measures Inspector of the Berkshire County Council on January 20, and 50 of them were underweight. This was stated by Mr. R. C. Kelly at the Reading County Magistrates' Court on March 11, when the Southern Gas Board entered a plea of guilty to 23 summonses alleging that it sold coke underweight at Earley on that date. The driver of the lorry which was inspected was Cecil Jones, who pleaded not guilty to 23 summonses alleging that he delivered underweight coke.

It was stated that Mr. R. G. Halford, Weights and Measures Inspector, saw Jones delivering coke to a house in Earley. He weighed each sack and found each one deficient in weight. 'But,' said Mr. Kelly, 'they were deficient only to a negligible amount, totalling only 10 lb., and were not the subject of charges.' Jones then went to another house to deliver ten sacks of coke. Mr. Halford weighed each sack as it was taken from the lorry. After the first five were found to be deficient Jones said to Mr. Halford, 'I am not delivering any more; I shall lay myself open to a £5 fine.'

Mr. Kelly said that the five sacks were short by 5 lb. (twice), 13 lb., 9 lb., and 14 lb. The lorry, owned by a contractor working for the Southern Gas Board, was then returned to the Board's yard. There were 47 sacks remaining on the lorry, and each was weighed. Seven of them were overweight, but only one by more than 7 lb. The other 40 were underweight by amounts ranging from 1 lb. to 16 lb.

Jones, on oath, said that he took 80 bags of coke out, and he guessed their weight as the scales were broken.

Mr. R. Elwood, on behalf of the Gas Board, said the Board realized that its load procedure in the past had not been all that it might, and had therefore tightened it considerably. Previously there had been no check on the number of bags taken out on the lorries; instead they had checked the total weight of the lorry as it passed out. This would not occur again. Mr. Elgood added that where the mistake came on this occasion was by not checking the sacks that Jones was taking out. Jones had already delivered 37 sacks, not 33. Therefore he took 84 sacks out with him, and not 80 as he alleged.

The Bench, after a retirement, imposed fines on the Southern Gas Board totalling £92 with 10 gns. costs—£4 on each of the 23 summonses. Jones was told by the Chairman, Mr. R. H. E. Bond, that he had been a little careless. He was fined 5s. on each of the summonses, a total of £5 15s

News in Brief

The Ministry of Fuel and Power has decided not to proceed with plans to prospect for open-cast coal in the watercatchment area of Elie and St. Monance, Fife.

The British Gas Staff Association whose national headquarters have been at 203, Knightsbridge, S.W.7, since 1948 move to a new address on March 25. The new address is: 34, Gloucester Gardens, Bayswater, London, W.2.

Change of Coal Merchant.—The Parliamentary Secretary to the Ministry of Fuel and Power, Mr. L. W. Joynson-Hicks, informed the House of Commons on February 28 that householders will this year be able to change their coal merchants after giving notice to their local fuel overseer at any time during the four-month period April 1 to July 31. Notices received before May 1 will become effective from May 1 and those received during May, June, and July as soon as possible thereafter.

Wantage, Berks, Urban District Council has called the attention of the Southern Gas Consultative Council to the fact that the present price of gas at Wantage is 3½d. above the price charged within the city of Oxford, although under an agreement approved prior to nationalisation the Urban Council and the Oxford Gas Company had agreed that the price paid at Wantage should not be more than 2.4d. per therm more than was charged in Oxford. The agreement, it was pointed out, was approved between the Council and the Company for the sale of the Council's gas undertaking.

MORLEY CAREERS EXHIBITION

The North Eastern Gas Board's stand at the Morley Careers Exhibition sponsored by the local Rotary Club and held in Morley Town Hall for a fortnight last month was a source of interest to the thousands of boys and girls approaching school leaving age who visited the exhibition. The show was said to be one of the most successful ever staged in Morley and the general standard of the exhibits was high. On the Gas Board's stand, which was designed and produced by the Board's Central Display Depôt, initial interest was created by the demonstrations given by home service advisers of a modern cooker and one of the new gas/electric washing machines. An industrial burner exhibit showing a flame failure device and thermostat in action was another attraction.

The many opportunities for careers in the gas industry were presented pictorially and diagrammatically.

At the North Eastern Gas Board stand at the Morley Careers Exhibition, Mr. J. H. Barratt, District Engineer and Manager, is seen talking to Miss Sheila Hannaway, principal boy at the Dewsbury Empire production of 'Babes in the Wood.' With his back to the camera is County Alderman H. Hardy, member of the North Eastern Gas Consultative Council.

TRADE NEWS

'Torque-arm' speed reducer

J. H. Fenner and Co., Ltd., power transmission engineers, announce the development of the 'Torque-arm' speed reducer. A special feature of this unit is the fact that it is *shaft mounted*—it is claimed to be the first shaft mounted speed reducer to be made in this country.

The Fenner 'torque-arm' speed reducer, made in four standard sizes, has a fixed reduction of 15:1, and power ratings of up to 12 h.p. With the addition of a vee-belt drive final fixed speeds of between 9 to 134 r.p.m. are attained. The range of application includes con-

'Torque-arm' speed reducer.

veyors and elevators, agitators and mixers, screens and graders, and similar slow speed machinery. The advantages of 'torque-arm' speed reducers are:—

(1) *Shaft mounted.* The reduction unit mounts directly on the driven shaft. It is secured simply by locking the driven shaft into the bore of the reduction unit by means of a collar at either end and anchoring the 'torque-arm' to the nearest fixed object. Bushes are available to adapt the shaft diameter to the bore diameter where the former is less than the latter. The important feature of shaft mounting is that it dispenses with bed plates, and couplings and eliminates tedious 'lining up' difficulties. This factor constitutes a considerable saving both in initial cost and in installation time.

(2) *Driven through Fenner taper-lock vee-belt drives.* A wide range of final fixed speed variation is attainable by using different diameter taper-lock pulleys. This final speed range lies between 9 and 134 r.p.m. The vee-belts also assist in absorbing shock loads; and vee-belt tensioning is greatly simplified by the turnbuckle adjustment on the torque-arm. This latter feature dispenses with the need for motor slide rails. The reduction unit incorporates helical steel gears shaved for quiet opera-

Industrial power trucks

It might now be said that industry is beginning to realize how large a part the movement of materials plays in total production costs, and consequently in selling price. The proportion of movement costs to total production costs may vary a great deal as between different industries, but experts have assessed that the former represents at least 25%-35% of the total cost of the average product, and in some cases may even reach as much as 75%. The materials handling engineer now constitutes an important part of the executive force of most of the larger concerns in the country.

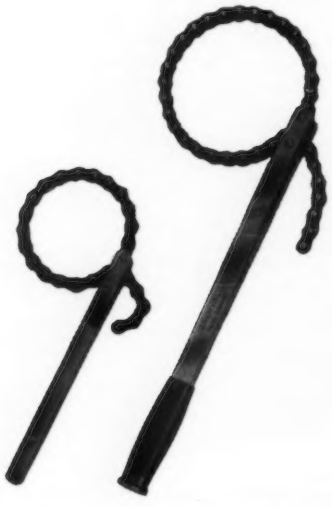
Developments have taken place in the design and performances of industrial power-driven trucks. The original fixed platform truck, acting as a straightforward carrier only, was soon supplemented by the elevating platform truck, used in conjunction with stillages, by means of which truck waiting time for loading or unloading was eliminated. There followed such developments as trucks carrying their own loading and unloading jib crane, trucks with high-lift platforms, trucks with tipping hoppers, means for handling special loads such as cable drums, early type fork trucks for dealing with tinplate, and tractors for haulage purposes. Probably the biggest development has been that of the modern type forklift trucks, which are now available with all kinds of attachments such as the crane attachment, bar or ram attachment, side load clamps, multi-prong attachment, brick-handling attachment, rotating head, and combined rotating head and clamp.

Good examples of the latest types of battery-powered trucks are provided by Ransomes, Sims & Jefferies, Ltd., who claim to be the pioneers of this class of works transport in this country.

The illustration shows a hopper truck. This type is to be found in use at some gas undertakings. End tipping, side tipping, or universal tipping hoppers can be provided. Where the truck is consistently used with the hopper, the latter is usually fixed to the truck. In cases where the truck can be usefully employed on other duties as well, the hopper can be mounted on a separate stillage and an ordinary elevating platform truck employed. Where tipping at a height is required, the forklift truck can carry out this work very efficiently, and there are several different means of tipping the hopper at the required height and re-setting.—*Ransomes, Sims & Jefferies, Ltd., Ipswich.*

tion and heat treated for long life. Ample capacity deep grooved ball bearings facilitate smooth running and steel-covered spring-loaded neoprene oilseals retain oil and exclude dirt. The cast iron housing, machined to give a clean appearance, is designed for minimum weight and ribbed for strength.—*J. H. Fenner and Co., Ltd., Marfleet, Hull.*

'Gripital' chain spanner

New and improved designs of the 'Gripital' chain spanner are now in production. Two models are at present available. A medium duty model, Mark

III, provides a grip capacity up to 4 in. diameter and has a handle 9 in. long. The heavy duty model, Mark IV, will take diameters up to 6 in., the handle being 15 in. long.

As will be seen from the illustration, the new design consists of two steel bars cranked or offset and built up to provide the gap into which the chain is fitted. The chain is of the laminated type made up in combinations to ensure the required strength.

The 'Gripital' chain spanner relies on the encircling grip of the chain which holds the object with a mild but positive grip. Within the stipulated capacities of each model the 'Gripital' will turn any shape, round, square, hexagonal and irregular, such as is to be found in nuts, bolts, jar lids, pipe fittings, chucks, pulleys, sprockets, radiator caps, valves, or whatever it will surround.—*Industrial Chain Supply Co., Ltd., 625, Fulham Road, London, S.W.6.*

'Epping Auto-shunter'

Organizations with limited goods traffic movement on their private sidings will be interested to learn of a new development for the 'Epping Auto-shunter' which increases its economic usefulness.

A special adaptation of the 'Muledozer' has been introduced which can be quickly fitted to or detached from the 'Epping Auto-shunter' and which enables the machine to undertake a useful range of bulldozing duties when not engaged upon its normal railway wagon shunting tasks.

The weight distribution arrangement of the 'Epping Auto-shunter' which helps to provide the necessary tractive effort for the shunting of goods wagons of up to 175 tons, is of course also available when the machine is employed for bulldozing duties and is of considerable advantage in this work.

F. E. Weatherill, Ltd., distributors of the 'Epping Auto-shunter' who announce this development, also advise us that they are now undertaking the manufacture of this machine.—*F. E. Weatherill, Ltd., Union Row, London, N.17.*

'Epping Auto-shunter' fitted with 'Muledozer' equipment.

TRADE PUBLICATIONS

Pipe fittings

Pipe fittings by Walter Slingsby & Co., Ltd., of Woodhouse Road, Keighley, Yorkshire, are described in their new catalogue No. 300. This is a comprehensive list giving specifications and prices of pipe fittings for all industrial purposes.

Leather packings

Rather than issue merely a catalogue listing the uses and merits of 'Vim' leather packings, Edgar Vaughan & Co., Ltd., of Wainwright Street, Birmingham, 6, have published a well-bound textbook dealing with practical aspects of hydraulic engineering. This book is available to any one interested.

Road tar

Among the many interesting articles in the latest quarterly edition of *Road Tar*—the publication of the British Road Tar Association—is one by the Chairman of the Association. In this he expresses his views on 'Fundamental Research and the Practical Tar Distiller.' The offices of the Association are at 9, Harley Street, London, W.1.

Newton Chambers brochure

Newton, Chambers & Co., Ltd., of Thorncliffe, near Sheffield, have published a new brochure illustrating the wide range of heavy industrial equipment designed and manufactured at Thorncliffe. Much of the brochure, of course, illustrates their gasmaking plant and ancillary equipment. Produced by the engineering division, the whole is both attractive and informative.

Wiggin nickel alloys

No. 31 in the publication *Wiggin Nickel Alloys* includes an article on heating by infra-red radiation. This article mentions the new type of infra-red heater employing either town's gas, butane or propane, which has been developed in Belgium. The gas, mixed with an appropriate proportion of air to form a combustible mixture, is fed through a porous refractory plate and ignited as it filters out through the pores of the material. Henry Wiggin & Co., Ltd., are at Thames House, Millbank, London, S.W.1.

Aveling-Barford News

The March-April edition of *Aveling-Barford News* describes how a contractor built six houses in six weeks at Erith, Kent, last December. The site was a 'sea of mud that the men found almost impossible to walk through.' The contractor transferred his 'half-yard dumper' from another site to carry sand, ballast, bricks and concrete. The haul was about 200 yds. one way, with about 40 yds. uphill, when loaded, at a gradient of one in eight. The depth of mud varied from 6 in. to 14 in. The contractor said he could not have worked at all had it not been for the machine. Aveling-Barford, Ltd., are at Grantham and Newcastle.

Gunite

One of the reinforced concrete structures reconditioned with Gunite for the City of Carlisle Gas Undertaking.

Gunite—concrete applied by air pressure—has numerous applications where its great density and extreme adhesion have exceptional value.

For repairing reinforced concrete it has particular merit, as, due to the method of application, a uniform density and adherence is obtained whenever Gunite is applied.

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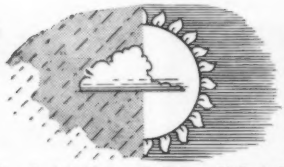
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The engagement of persons answering these advertisements must be made through a Local Office of the Ministry of Labour or a Scheduled Employment Agency if the applicant is a man aged 18-64 inclusive or a woman aged 18-59 inclusive unless he or she, or the employment, is excepted from the provisions of the Notification of Vacancies Order, 1952.

THE UNIVERSITY OF LEEDS

DEPARTMENT OF COAL GAS AND FUEL INDUSTRIES WITH METALLURGY AND CHEMICAL ENGINEERING

THE Council invites applications for four posts in the Department in chemical engineering, in gas engineering and in fuel technology. Appointments will be made on the Lecturer scale and on the Assistant Lecturer scale (both at present under review). Applications (three copies) stating date of birth, qualifications and experience, together with the names of three referees, should reach the Registrar, The University, Leeds, 2 (from whom further particulars may be obtained) not later than April 30, 1955.

NORTH WESTERN GAS BOARD

APPLICATIONS are invited from suitably qualified persons for the following pensionable appointments :—

WIRRAL GROUP
SENIOR INDUSTRIAL GAS ENGINEER

(Salary within Grade A.P.T. 9—£655-£755 per annum)

Applicants should have had considerable experience in the application of gas to industrial and large scale commercial users.

Detailed applications, giving the names of two referees, should reach the General Manager, N.W.G.B. (Wirral Group), Hind Street, Birkenhead, within fourteen days.

EAST LANCASHIRE GROUP
DISTRICT FITTINGS INSPECTOR—BLACKBURN DISTRICT

(Salary within Grade A.P.T. 4—£335-£525 per annum)

Candidates should hold a qualification in Gas Engineering (Supply) and/or in gas fitting and have had good experience in the duties required.

The successful applicant will be responsible for the inspection and supervision of the installation of appliances in consumers' premises. He should be capable of preparing estimates and have a knowledge of salesmanship.

Detailed applications, giving the names of two referees, should reach the General Manager, N.W.G.B., (East Lancashire Group), Cardwell Place, Blackburn, within fourteen days.

SOUTH EASTERN GAS BOARD

ENGINEERING DRAUGHTSMAN
SUSSEX DIVISION

APPLICATIONS are invited for the position of an ENGINEERING DRAUGHTSMAN at the Divisional Headquarters in Brighton, Sussex.

Candidates should have had previous experience in the Gas Industry, and must be able to prepare schemes, working drawings and specifications in connection with gas plant and layout. A knowledge of reinforced concrete and structural steelwork would be considered an advantage.

Salary within Grades 6-8 (Provincial 'A') £530-£705, according to qualifications and experience.

Applications, stating age, qualifications, experience and present position and quoting reference V10/530, should reach the undersigned within fourteen days.

R. J. McCRAE,
Personnel Manager.

Katharine Street,
Croydon.

EASTERN GAS BOARD

CAMBRIDGE DIVISION
TECHNICAL ASSISTANT

APPLICATIONS are invited for the position of TECHNICAL ASSISTANT at the Wisbech and/or March undertakings where there are installations of continuous vertical retorts.

The salary will be in accordance with A.P.T. Grade 5, Provincial 'A' (£500 to £580 per annum), the initial placing depending on age and experience.

The successful candidate may be required to pass a medical examination and, unless already subject to a Pension Scheme by virtue of the Gas (Pension Rights) Regulations, 1950, will be required, if eligible, to join the Eastern Gas Board Staff Pension Scheme within six months from taking up the appointment.

Applications giving full details of training, qualifications and experience together with the names of two referees should be sent to the General Manager, Eastern Gas Board (Cambridge Division), 52, Sidney Street, Cambridge, by April 7, 1955.

EASTERN GAS BOARD

CAMBRIDGE DIVISION
FEMALE HOME SERVICE ADVISER—CAMBRIDGE DISTRICT

APPLICATIONS are invited for the position of HOME SERVICE ADVISER at the Cambridge District. Candidates should possess a recognised Diploma in Cookery or Domestic Science and be capable of conducting cookery demonstrations and of giving advice on the use of gas appliances. Salary will be in accordance with A.P.T. Grade 5 (Provincial 'A') £400-£464.

The successful candidate may be required to pass a medical examination and unless already subject to a Pension Scheme by virtue of the Gas (Pension Rights) Regulations, 1950, will be required, if eligible, to join the Board's Staff Pension Scheme within six months from taking up the appointment.

Applications stating age, experience, present position, training and qualifications, together with the names of two referees, should reach the undersigned, within fourteen days of the appearance of this advertisement.

J. HUNTER-RIOCH,
General Manager.

52, Sidney Street,
Cambridge.
March 15, 1955.

EASTERN GAS BOARD

CAMBRIDGE DIVISION
TECHNICAL ASSISTANT (DISTRIBUTION)

APPLICATIONS are invited for the position of TECHNICAL ASSISTANT (DISTRIBUTION) at the Divisional Chief Office at Cambridge.

Applicants should have had good practical experience of main and service laying and in the operation of a Distribution Department of a medium or large undertaking. They should also possess the Higher Grade Certificate of the Institution of Gas Engineers in Gas Engineering (Supply), or equivalent qualification.

The successful candidate will be required to assist in the preparation of all types of mainlaying projects, including the design of housing estate layouts, feeder and trunk mains and integration mains.

The salary will be within Grade A.P.T. 9, Provincial 'A' (£655 to £755) with placing according to age and experience.

The successful candidate may be required to pass a medical examination and, unless already subject to a Pension Scheme, by virtue of the Gas (Pension Rights) Regulations 1950, will be required, if eligible, to join the Eastern Gas Board Staff Pension Scheme within six months from taking up the appointment.

Applications giving full details of training, qualifications and experience, together with the names of two referees, should be sent to the General Manager, Eastern Gas Board (Cambridge Division), 52, Sidney Street, Cambridge, by April 7, 1955.

EASTERN GAS BOARD

TOTTENHAM DIVISION
LABORATORY ASSISTANT/WORKS TESTER—LEESIDE CHEMICAL WORKS—TOTTENHAM

APPLICATIONS are invited for the position of LABORATORY ASSISTANT/WORKS TESTER at Leeside Chemical Works.

Applicants who should be not less than 21 years of age, and have reached Inter. B.Sc. standard in chemistry or its equivalent, will be required to undertake duties which include all routine testing and analysis in connection with the Chemical Works and perform Sunday and Bank Holiday duties in accordance with a rota.

The salary will be within Grade A.P.T. 4 (£365-£555) of the National Salary Scales for Gas Staffs according to qualifications and experience.

The successful applicant may be required to pass a medical examination and, unless already subject to a Pension Scheme by virtue of the Gas (Pension Rights) Regulations 1950, will be required if eligible to join the Eastern Gas Staff Pension Scheme within six months from taking up the appointment.

Applications, giving age, and details of experience and qualifications, should reach the Divisional Personnel Manager, Eastern Gas Board (Tottenham Division), Woodall House, 658, Lordship Lane, Wood Green, N.22, not later than Saturday, April 2, 1955.

SOUTH WESTERN GAS BOARD

BRISTOL/BATH DIVISION
PRODUCTION DEPARTMENT

APPLICATIONS are invited for the position of TECHNICAL ASSISTANT at the Avon Street Gasworks, Bristol.

The appointment will be within Grades A.P.T. 5, 6 and 7, according to experience and ability.

Candidates should have good knowledge and experience of gas manufacture. The manufacturing plant at Avon Street Works consists of Horizontal Retorts and Water Gas Plant.

The successful applicant will be required to pass a medical examination, and to join the Board's Staff Pension Scheme, unless he is otherwise ineligible in accordance with the Rules of the Scheme.

Applications in writing, giving the names of two referees, should be received by the undersigned not later than April 16, 1955.

CHARLES R. INGHAM,
Production Engineer and Manager.

Radiant House,
Bristol, 1.

EAST MIDLANDS GAS BOARD

LINCOLNSHIRE DIVISION
RESIDENT FITTER—BARROW-ON-HUMBER

APPLICATIONS are invited from qualified gas fitters for the above post in the Scunthorpe Group. The person appointed will be employed during the day on gas fitting work in the Barton/Barrow district. After normal working hours, he will be responsible for supervision of the small holder station at Barrow-on-Humber and will deal with any emergency calls in the Barrow area.

The salary payable will be in accordance with Intermediate Grade 4 (£420-£465) with Class 1 conditions of service. A house is available at Barrow-on-Humber under a service occupation agreement at a reasonable weekly payment.

Applications stating age and giving details of education, qualifications and experience and quoting the names of two referees should be sent to the Group Manager, East Midlands Gas Board, Dawes Lane, Scunthorpe, to arrive not later than March 31, 1955.

BERNARD CLARKE,
Divisional General Manager.

Lincoln.
March 18, 1955.

WALES GAS BOARD

ABERTILLERY UNDERTAKING
HOME SERVICE ADVISER

APPLICATIONS are invited from persons holding a Diploma in Domestic Science or equivalent qualifications, for the post of Home Service Adviser to serve the areas of Abertillery, Blaina, Brynmawr, Beaufort and Ebbw Vale.

Applicants should be fully qualified in Cookery and other Demonstrations, and should be interested in Sales and Showroom organisation. The person appointed will be required to visit consumers in their own homes to advise on the correct use of gas appliances.

The salary will be within the range, Grade A.P.T. 4, Provincial 'A' (£268-£420 per annum) of the Gas Staffs Agreement, according to experience and qualifications.

The successful applicant will be required to pass a medical examination and to contribute to the Board's Superannuation Scheme.

Applications, stating age, qualifications, experience, and names and addresses of two persons to whom reference can be made, should be received by the undersigned within fourteen days of the publication of this advertisement.

D. S. DAVIES,
Engineer and Manager.

Gas Offices,
Old Aberbeeg Road,
Abertillery, Mon.

(Classified advertisements continued on page 806)

APPOINTMENTS VACANT (ctd.)

MINISTRY OF FUEL AND POWER

GAS EXAMINERS

THE Civil Service Commissioners invite applications from men and women for about 12 pensionable posts mostly in the provinces, including Scotland and Wales.

Age at least 26 on January 1, 1955. Candidates must have passed, or been exempted from, the Inter B.Sc. examination in Physics, Chemistry and Mathematics or possess the Higher Grade Certificate (Gas Manufacture) of the Institution of Gas Engineers or have had at least five years' experience in official testing of gas for calorific value, purity and pressure.

Inclusive remuneration for a 45½ hour week in London (Men) £736–£947 : (Women) £638–£813. A starting salary above the minimum may be given in appropriate cases. Somewhat less in provinces. Promotion prospects.

Full particulars and application forms from Civil Service Commission, Scientific Branch, 30, Old Burlington Street, London, W.1, quoting No. S.4442/55. Application forms to be returned by April 20, 1955.

NORTHERN GAS BOARD

WESTERN GROUP—
PENRITH DIVISION
TECHNICAL ASSISTANT—
PENRITH WORKS

APPLICATIONS are invited for the position of TECHNICAL ASSISTANT at the Penrith Works.

Candidates should have experience in works control, be prepared to take over control of the works during the absence of the Works Manager, and assist on Distribution matters.

The Salary will be within Grades A.P.T. IV/V of the National Salary Scales for Gas Staffs, depending upon qualifications and experience.

The person appointed may be required to pass a medical examination and will be required to join the Board's Staff Pension Scheme.

Applications, stating age, experience and qualifications, with names of two referees, should be addressed to the Divisional General Manager, Northern Gas Board, 19, King Street, Penrith, Cumberland, to arrive not later than Tuesday, April 12, 1955.

A. R. CROFT,
Group General Manager.

March 17, 1955.

NORTHERN GAS BOARD

TEES-SIDE DIVISION
HOME SERVICE ADVISER AND DEMONSTRATOR

APPLICATIONS are invited for the position of HOME SERVICE ADVISER AND DEMONSTRATOR. Salary within Grade A.P.T. 4/5 (£268–£464) of the National Joint Council for Gas Staffs. Initial placing according to qualifications and experience.

Candidates should be qualified in Domestic Science and capable of conducting Demonstrations and Lectures in Domestic Subjects, and giving advice in the use of gas appliances.

The successful candidate will be required to pass a medical examination and join the Board's Pension Scheme.

Applications, stating age, personal details, qualifications and experience, together with the names of two referees should be addressed to the undersigned so as to reach him not later than first post on April 2, 1955.

JOHN W. PALLISTER,
Divisional General Manager.

Gas Works,
Commercial Street,
Middlesbrough.
March 16, 1955.

WEST MIDLANDS GAS BOARD

WORCESTERSHIRE-HEREFORDSHIRE DIVISION
ENGINEER AND MANAGER,
REDDITCH GROUP

APPLICANTS should possess the ability to administer and control all departments of a 1,500 million cubic feet per annum undertaking, equipped with modern gasmaking, by-product and distributing plant.

The commencing salary will be £1,300 per annum.

The post is pensionable and the successful candidate may be required to pass a medical examination.

Applications, stating age, qualifications and experience, together with the names of two referees, should be addressed to the Industrial Relations Officer, West Midlands Gas Board, 6, Augustus Road, Edgbaston, Birmingham, 15, to reach him within fifteen days of the appearance of this advertisement.

J. C. INGRAM,
Secretary to the Board.

WEST MIDLANDS GAS BOARD

BIRMINGHAM AND DISTRICT DIVISION
DIVISIONAL CONSTRUCTIONAL ENGINEER

THE successful applicant will be responsible to the Divisional Engineer for all new construction of plant and buildings at the five Gas Works in the Division and will have control of the Divisional and Works Drawing Offices.

Candidates must have had considerable experience in the design, layout and construction of all Gas Works plant as well as in building and civil engineering work, including reinforced concrete.

The commencing salary will be not less than £1,100 per annum.

The post is pensionable and the successful candidate may be required to pass a medical examination.

Applications, stating age, qualifications and experience, together with the names of two referees, should be addressed to the Industrial Relations Officer, West Midlands Gas Board, 6, Augustus Road, Edgbaston, Birmingham, 15, to reach him within fifteen days of the appearance of this advertisement.

J. C. INGRAM,
Secretary to the Board.

WEST MIDLANDS GAS BOARD

BIRMINGHAM AND DISTRICT DIVISION
DEPUTY DIVISIONAL SALES AND SERVICE OFFICER

CANDIDATES must have a wide experience in the administration of a large Sales and Service Department. The duties of the position are mainly concerned with the control of Showrooms and Service Centres, Meter and Appliance Repair Shops and Stores in the Division, which has approximately 400,000 consumers. Experience in the control of manual and non-manual staff is essential.

Applicants should be Corporate Members of the Institution of Gas Engineers.

The commencing salary will be not less than £1,100 per annum.

The post is pensionable and the successful candidate may be required to pass a medical examination.

Applications, stating age, qualifications and experience, together with details of previous posts and the names of two referees, should be addressed to the Industrial Relations Officer, West Midlands Gas Board, 6, Augustus Road, Edgbaston, Birmingham, 15, to reach him within fifteen days of the appearance of this advertisement.

J. C. INGRAM,
Secretary to the Board.

WEST MIDLANDS GAS BOARD

BIRMINGHAM AND DISTRICT DIVISION
DEPUTY WORKS ENGINEER
SWAN VILLAGE

THE person appointed must be capable, in the absence of the Engineer, of taking charge of the Works which has a daily capacity of 17 million cubic feet of coal gas and 6 million cubic feet of C.W.G. Candidates must have had a sound practical training and must have held a responsible position on a large Gas Works.

Corporate Membership of the Institution of Gas Engineers is a necessary qualification and possession of an engineering degree or Diploma in Gas Engineering will be an advantage.

The salary will be within the range £1,100 to £1,200 per annum.

The post is pensionable and the successful candidate may be required to pass a medical examination.

Applications, giving details of age, qualifications and experience, together with the names of two referees, should be addressed to the Industrial Relations Officer, West Midlands Gas Board, 6, Augustus Road, Edgbaston, Birmingham, 15, to reach him within fifteen days of the appearance of this advertisement.

J. C. INGRAM,
Secretary to the Board.

FOREMAN ERECTOR fully conversant with the erection of Steel Gasholders and C.I. Purifiers, required by Midland Engineering firm. Applicants must be able to take complete charge of all work in connection with site requirements, including rivetting, testing, etc., and willing to undertake work out of town. Applicant should state age and give full details of previous experience. Apply : No. 232, *Gas Journal*, 11, Bolt Court, Fleet Street, London, E.C.4.

EDUCATIONAL

THE GAS COUNCIL

RESEARCH SCHOLARSHIPS

THE Gas Council invites applications for five Research Scholarships from graduates or prospective graduates in physics, chemistry or engineering at British Universities. The scholarships will be awarded for a period of three years from September 1, 1955, and the Universities in which they will be tenable are as follows:—

University of Oxford ...	Departments of Chemistry.
University of Cambridge	Department of Chemical Engineering.
University of London ...	Department of Chemical Engineering at either the Imperial College of Science and Technology or University College.
University of Birmingham	Department of Chemical Engineering.
University of Glasgow ...	Department of Chemistry.

The subject proposed for research must afford scope for original work and be of a character approved by the Research Committee of the Gas Council which is interested in problems related to the manufacture, distribution or use of gas. Each scholarship will carry an allowance at the rate of £350 a year together with the payment of University and College fees.

Particulars and application forms may be obtained from the Secretary, the Gas Council, 1, Grosvenor Place, London, S.W.1, or from the Head of any one of the University Departments named above. Applications should be submitted on or before April 15, 1955, to the Secretary, the Gas Council, or, if the candidate is a student in one of the University Departments named above, to the Head of that Department.

March 15, 1955.

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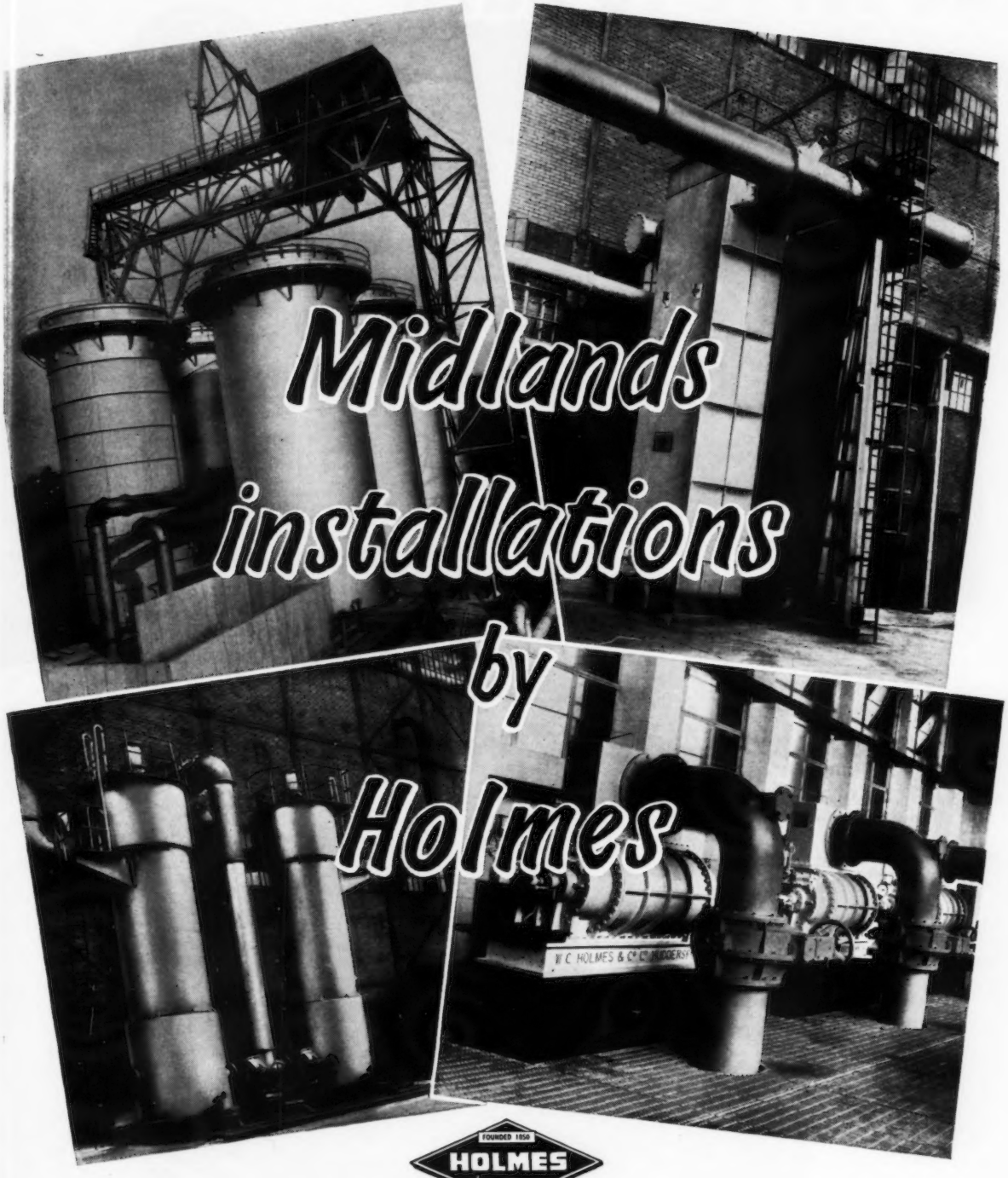

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HOLMES
HUDDERSFIELD

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C 4280

we serve to burn

"Fishtail" type burner *with two-armed stamped pattern injector for heating liquid in tanks by submerged horizontal combustion tubes. For use with low pressure gas supplies.*
Size Range: *1", 1¼", 1½", 2" and 2½" outlets.*
Capacity Range: *45-280 cu. ft. of gas per hour.*

Note.—These four burner heads are for high pressure gas or low pressure gas and air blast.

Brass non-blow-off head types: *deal with 5 to 10 cu. ft. of gas per hour.*

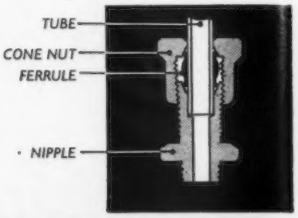
Stainless steel, "F" type head, burner: *deals with 8 cu. ft. of gas per hour.*

Perforated head type burner: *deals with 10 or 15 cu. ft. of gas per hour.*

Type 2 Mixture Controller, *for controlling quality of air/gas mixture irrespective of varying pressures and resistances. Temperature control is varied by manipulation of the air cock only.*
Capacity Range: *from 130 to 1380 cu. ft. of gas per hour according to air pressure (½ lb. to 1lb.) and size. For low pressure gas systems.*
Air Inlets: *1", 1¼", 1½" and 2" diameters gas thread.*

DID YOU KNOW?

KEITH BLACKMAN have been making compression joints for many years and the present design embodies features developed as a result of this long experience. Notice that the shape of the ferrule is such that the joint is made without unduly stressing the tube.



INDUSTRIAL GAS EQUIPMENT

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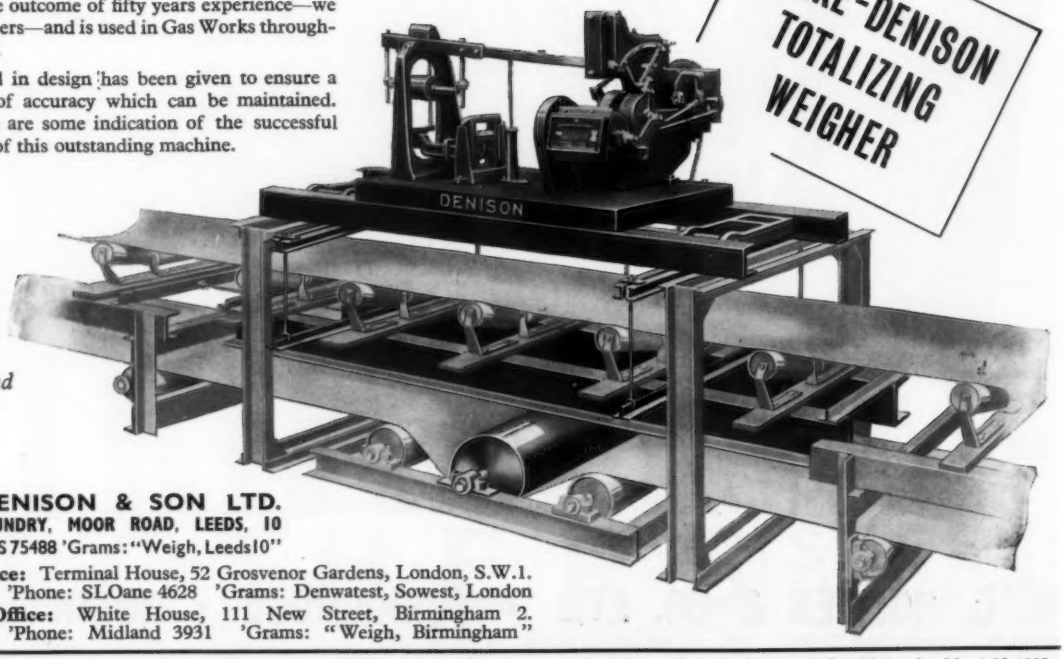
510

Weigh material in transit on your conveyor with the

BLAKE-DENISON TOTALIZING WEIGHER

Model No. 120. This is a fully-automatic continuous weigher and totalizer, driven by the returning empty belt. It is the outcome of fifty years experience—we were the pioneers—and is used in Gas Works throughout the world.

Special regard in design has been given to ensure a high degree of accuracy which can be maintained. Repeat orders are some indication of the successful performance of this outstanding machine.



May we send you further details?

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'Phone: SLOane 4628 'Grams: Denwatest, Sowest, London
Midlands Office: White House, 111 New Street, Birmingham 2.
'Phone: Midland 3931 'Grams: "Weigh, Birmingham"

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CONTINUOUS OR INTERMITTENT VERTICALS

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GC2

Wonders of the World

The STATUE of ZEUS

THIS was the work of the greatest of Greek Sculptors, Pheidias of Athens. It was carved in marble inlaid with ivory and gold and when completed was placed in the Temple of Zeus at Olympia during the fifth century B.C. Nearly a 1000 years later it was removed to Constantinople where soon afterwards it was destroyed by fire.

The Wonders of the Modern World will be chronicled by posterity and will reveal the indispensable contribution of steel tubes to these achievements.

WELLINGTON TUBE WORKS LTD

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